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UNIVERSITÉ DE MONTRÉAL

THREE ESSAYS ON THE IMPACT OF NON-TARIFF BARRIERS AND VOLUNTARY ENVIRONMENTAL STANDARDS ON INTERNATIONAL TRADE

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DEDICATION

To Mohamed and my beloved parents

For their ultimate love and support

To Ella and Hana, whose love of learning is as inspiring as it is immense

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RÉSUMÉ

Depuis les années 1940, des progrès considérables ont été accomplis dans la mondialisation des échanges, grâce à la libéralisation des barrières tarifaires au commerce international. Toutefois, les barrières non tarifaires sont devenues plus fréquentes. La tension dans le système commercial international est de plus en plus axée sur les normes et les obstacles techniques au commerce (OTC). Sur le marché mondial, on craint que ces barrières techniques ne soient des tentatives de restreindre l'accès au marché au moyen de règles imposées sur les caractéristiques des produits et les processus de production.

Cette thèse vise à explorer les impacts des barrières non tarifaires et plus précisément des obstacles techniques sur le commerce international à la fois du point de vue des entreprises et du point de vue des échanges internationaux. De plus, cette recherche va étudier plus spécifiquement les barrières techniques environnementales telles que l'éco-labelling. Pour cette raison, la présente thèse étudie trois questions de recherche : (i) Est-ce que les entreprises considèrent les barrières non tarifaires comme un obstacle majeur au commerce ?, (ii) différenciées par catégories, comment les obstacles techniques au commerce affectent le commerce international et (iii) les programmes d'éco-labelling ont-ils une incidence sur le commerce international ?

Pour répondre à la première question de recherche, des données transversales issues des enquêtes de la Banque mondiale auprès de 10 268 entreprises réparties dans 81 pays couvrant la période allant de 2006 à 2014 ont été analysées. L'étude se concentre sur quatre barrières non tarifaires: les règlementations douanières et commerciales, le taux d'imposition, l'administration fiscale et les licences et permis commerciaux. Les entreprises ont été analysées en fonction des niveaux d'exportation et des zones géographiques.

Pour répondre à la deuxième question, une base de données qui classe les obstacles techniques au commerce par catégorie et par secteur a été constituée. La base de données comprenait les exportations dans les secteurs agricole et industriel de la Chine (pays émergent) et des États-Unis (pays développé) vers les membres de l'Union européenne couvrant la période de 2001 à 2015. D'autres facteurs tels que la durée de l'adhésion à l'UE, la taille du marché, la similitude du marché et la distance ont été inclus dans le modèle de gravité appliquée. Pour répondre à la troisième question, une base de données comprenant les certifications ISO 14001 de tous les pays et contenant les exportations de 153 pays au Canada de 2001 à 2015 a été créée. Les variables

restantes ont servi de variables indépendantes, y compris les variables de gravité telles que la taille du marché, la similarité du marché, la distance, l'appartenance au GEN du pays exportateur, l'adhésion à l'OMC, les accords de libre-échange (ALE) et l'accord de reconnaissance mutuelle (ARM) avec le Canada.

La thèse est organisée en huit chapitres: le premier chapitre de la thèse présente le contexte des obstacles non tarifaires et techniques au commerce, ainsi que les règlements d'éco-étiquetage et les approches visant à éliminer les impacts commerciaux négatifs de ces règlementations. Le deuxième chapitre fait un examen attentif de la documentation connexe portant principalement sur les domaines suivants: définitions et classifications des OTC, OTC dans la perspective mondiale, OTC dans la perspective des secteurs, OTC au niveau micro, élimination des OTC et approches de quantification des OTC. Le troisième chapitre présente la méthodologie de recherche et les trois questions de recherche. La méthodologie de recherche comprend l'enquête auprès des entreprises pour répondre à la première question qui est: « Est-ce que les entreprises des pays du Sud considèrent-elles les obstacles non tarifaires comme un sérieux obstacle à leurs exportations ? » La méthodologie inclut également le modèle de gravité abordant les deuxième et troisième questions de recherche comme: « différenciées par catégories, comment les TBT affectent le commerce international ? », Et «comment les programmes d'éco-étiquetage non harmonisés affectent le commerce international? Le quatrième chapitre, intitulé « Alléger le fardeau des obstacles non tarifaires : une analyse des données au niveau régional et au niveau de l'entreprise », aborde soigneusement la première question et contribue à mieux dissimuler les effets des obstacles non tarifaires sur les exportations des entreprises de diverses régions et avec différents niveaux d'exportation. La conclusion de ce chapitre montre que, par exemple, les licences d'exploitation et les permis et le taux d'imposition sont plus susceptibles d'être classés comme un obstacle important pour les entreprises dont le niveau d'exportation est compris entre 51 et 75%. Le cinquième chapitre intitulé « Obstacles techniques au commerce: étude de cas européen » aborde la deuxième question de recherche de la thèse et contribue à comprendre que, différenciées par catégorie, les OTC entravent les exportations de la Chine et des États-Unis vers les pays de l'Union européen. Par rapport au secteur industriel pour les deux. Le résultat de ce chapitre montre que les impacts commerciaux des OTC avec un objectif premier non similaire ne sont pas les mêmes que pour les obstacles non tarifaires dans différentes catégories. La protection des OTC humains et de santé ou de sécurité a des effets positifs sur les exportations des deux

secteurs en provenance de Chine et les TBT dans la catégorie protection de l'environnement et exigences de qualité créent des obstacles aux exportations de la Chine et des États-Unis dans les secteurs industriels. Le chapitre six intitulé « Les obstacles techniques au commerce: une perspective canadienne sur l'éco-étiquetage » traitait de la troisième question de recherche et de la façon dont les règlements non alignés influent sur le commerce international. Les résultats contribuent à un meilleur apprentissage des impacts des programmes d'éco-étiquetage harmonisés, du Réseau mondial d'éco-étiquetage (GEN) et de l'Organisation internationale de normalisation (ISO) sur les exportations vers le Canada. Les résultats montrent que la certification ISO 14001 a un impact positif sur les exportations vers le Canada; Cependant, ces impacts ne sont pas assez importants et le fait de ne pas obtenir la norme ISO 14001 crée un obstacle au commerce. De plus, l'adhésion à GEN favorise grandement les exportations vers le Canada, en particulier pour les pays qui adhèrent à une ALE ou à un ARM avec le Canada. Le chapitre sept résume la conclusion générale des chapitres précédents. Le chapitre huit explique les contributions théoriques et pratiques de la dissertation. De plus, ce chapitre comprend des recommandations pratiques à l'intention des gestionnaires et des décideurs des entreprises (multinationales) pour que les obstacles non tarifaires et les obstacles techniques au commerce entravent le commerce dans les régions et les secteurs. Ce chapitre comprend des recommandations pratiques à l'intention des ambassadeurs des accords commerciaux pour surveiller les problèmes liés aux obstacles non tarifaires et aux obstacles techniques au commerce dans les pays à faible niveau de développement. Ce chapitre expose aussi la limite de la recherche actuelle et les recommandations pour des recherches futures.

ABSTRACT

Since the 1940s, considerable progress has been made in trade globalization, through liberalizing the tariff barriers to international trade. Consequently, non-tariff barriers (NTBs) have become more prevalent. Among NTBs, tension in the international trading system is increasingly focused on standards and technical barriers to trade (TBTs). In the global market, there are concerns about that TBTs may be attempts to restrict market access through rules imposed on products characteristics and production processes.

This dissertation aims to explore the impacts of NTBs and TBTs on international trade. Furthermore, this dissertation attempts to analyze NTBs at the micro level (firm) while keeping in perspective TBTs at the macro level. In addition, this dissertation studies the specific TBT referred to as ecolabelling, and the possible approaches on eliminating its negative trade impacts. For this reason, the present dissertation investigates three particular research questions: (i) How severely, if at all, do enterprises rate non-tariff barriers as obstacles to trade ?, (ii) differentiated by categories, how do TBTs affect the international trade and (iii) how do un-harmonized ecolabelling programs impact international trade?

To address the first question, a cross-sectional database from the World Bank Enterprise Surveys of 10,268 firms across 81 countries covering the period from 2006 to 2014 was conducted. The study focuses on four NTBs: customs and trade regulations, tax rate, tax administration, and business licensing and permits. Firms were studied according to levels of exportation and geographical locations. To address the second question, a database was compiled which classified TBTs based on their primary objectives (category) as well as their respective sectors. This database translated the text on TBT notifications of TBT WTO Agreement to number in order to calculate the trade impacts of TBTs in different categories and sectors. The database included imports in agricultural and industrial sectors from China (representing emerging countries) and the US (developed country) to the members of the European Union, spanning the period from 2001 to 2015 as the dependent variable. Other factors such as the length of the EU membership, market size, market similarity, and distance of importing and exporting countries, were included in the applied gravity model. To address the third question, a database including the International Organization for Standardization (ISO) 14001 certifications of all countries was created, containing the exports from 153 countries to Canada from 2001 to 2015 as a dependent variable

was created. The remaining variables served as independent variables, including gravity variables such as market size, market similarity, distance, GEN membership of the exporting country, WTO membership, and binding in Free Trade Agreement (FTA) and Mutual Recognition Agreement (MRA) with Canada.

The dissertation is organized as follows: the first chapter of the dissertation explains the context of non-tariff and technical barriers to trade, as well as ecolabelling regulations and approaches to eliminating negative trade impacts of such regulations. The second chapter includes a careful review of related literature, mainly focusing on areas such as: TBTs' definitions and classifications, TBTs in global perspective, TBTs in sectors perspective, TBTs in micro level, elimination of TBTs, and quantification approaches of TBTs. The third chapter unfolds the research methodology and the three research questions. The research methodology includes the business survey to address the first question, that is: "How severely, if at all, do enterprises rate non-tariff barriers as obstacles to trade?". The methodology utilizes the gravity model to address the second and third research questions as: "differentiated by categories, how TBTs affect the international trade?", and "how ecolabelling programs impact international trade?" The fourth chapter entitled "Easing the burden of non-tariff barriers: a regional and firm-level data analysis" carefully addressed the first question and contributes to a better understanding of trade impacts of NTBs on export of firms in various regions and with different levels of exportation. The finding of this chapter shows that, for example, the *business licensing and permits* and *tax rate* are more likely to be ranked as a severe barrier for the firms with 51-75% level of exports. The fifth chapter entitled "technical barriers to trade: A European case study" addresses the second research question of the dissertation. It contributes to our our understanding of which TBTs, as differentiated by categories, which TBTs impede imports from China and the US to European Union countries, in agricultural sector versus industrial sectors, respectively. The result of this chapter shows that trade impacts of the TBTs with not similar primary objective, is not the same as well as NTBs in different categories. Our results show that TBTs in the category "*protection of human and health or safety's"* have positive impacts on exports in both sectors from China, while TBTs in the category "*protection of the environment* and *quality requirements"* create barrier on imports from both China and the US in industrial sectors. Chapter six titled "Technical barriers to trade: A Canadian perspective on ecolabelling" addresses the third research question asking and how incongruent regulations can impact international trade. The findings

contribute to a better understanding of the impacts of harmonized ecolabelling programs, Global Ecolabeling Network (GEN) and International Organization for Standardization (ISO) on exports to Canada. Findings show that holding ISO 14001 certifications has a positive impact on exports to Canada; however, these impacts are not significant enough, and not obtaining ISO 14001 creates a barrier to trade. In addition, GEN membership significantly promotes exports to Canada, especially for countries bound in an FTA or MRA with Canada. Chapter seven summarized the general finding of the previous chapters. Chapter eight explains the theoretical and practical contributions of the dissertation by providing recommendations on how to find the NTBs and TBTs which impede trade in specific regions and sectors. For instance, managers and decision makers of (multinational) enterprises such as negotiators of trade agreements may monitor the problematic NTBs and TBTs for countries in lower levels of development. Moreover, this chapter includes the limitations of current research on the subject and provides concrete recommendations for further studies in the field.

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LIST OF SYMBOLS AND ABBREVIATIONS

NTB	Non-Tariff Barrier
TBT	Technical Barriers to Trade
SPS	Sanitary and Phytosanitary measure
WTO	World Trade Organization
FTA	Free Trade Agreement
MRA	Mutual Recognition Agreement
ISO	International Standard Organization
GEN	Global Ecolabelling Network
EU	European Union
OECD	Organization for Economic Co-operation and Development
TREM	Trade-Related Environmental Measure
UNEP	United Nations Environment Programme
ELO	Ecolabelling Organization
FSC	Forest Stewardship Council
WCO	Wine Council of Ontario
EMS	Environmental Management System
ECP	Environmental Choice Program

LIST OF APPENDICES

CHAPTER 1 INTRODUCTION

As concern of globalization rises, discussions on decreasing barriers on international trade increase. Barriers on trade are not limited to tariffs and quotas, but also include non-tariff barriers (NTBs). The NTBs are considered as 'within the border' barriers. However, the literature shows the NTBs either have an ambiguous trade impact or no impact at all, while others indicate that NTBs may facilitate trade or restrict it (Sithamparama et al., 2017).

There are various approaches on classifications of the NTBs. Some scholars divide the NTBs into internal taxes, health and sanitary regulations, government policies, and administrative barriers (Carrère & De Melo, 2011). The World Trade organization (WTO, 2011) proposed a classification on NTBs that contains: charges on importers, customs, administrative procedures, Sanitary and Phytosanitary measure (SPS), and Technical Barriers to Trade (TBTs).[1]

Among the various forms of NTBs, so-called TBTs, which mainly include standards and technical regulations, are relatively new yet very important (Bao and Qiu, 2012). TBTs are considered the most challenging barriers to be measured (Deardorff & Stern, 1997). However, according to Bao and Qiu (2012), if TBTs are issued properly, they can even promote trade, but if they are set discriminatorily and used as an excuse for protection, they may instead create barriers to trade.

Traditionally, there are many challenges accompanying TBTs. First, there are regulations and standards that are different from international norms. Second, the regulations and standards proposed by a country are matched more with their national producer rather than being welfare protective. Third, unequal access to testing and certification systems among producers of different countries, and forth, the lack of transparency in the systems for developing technical regulations in most countries (Hufbauer and Elliott, 1994). In addition, certain products are subject to more technical regulations than others (Messerlin and Zarrouk, 2000). For instance, a country producing peanuts faces more difficulties applying the technical regulations on health compared to a wood producing country. All of these factors, attract the attention of researchers to study technical regulations from many perspectives, such as the global or micro-levels, or

[1] WTO annual report, 2011

consumer willingness to pay, trade agreements, trade of countries with different level of development, and trade of different sectors. Moreover, the rapid growth of TBTs over last decades concerned the countries in the concept of globalization and international trade (see figure 1-1)

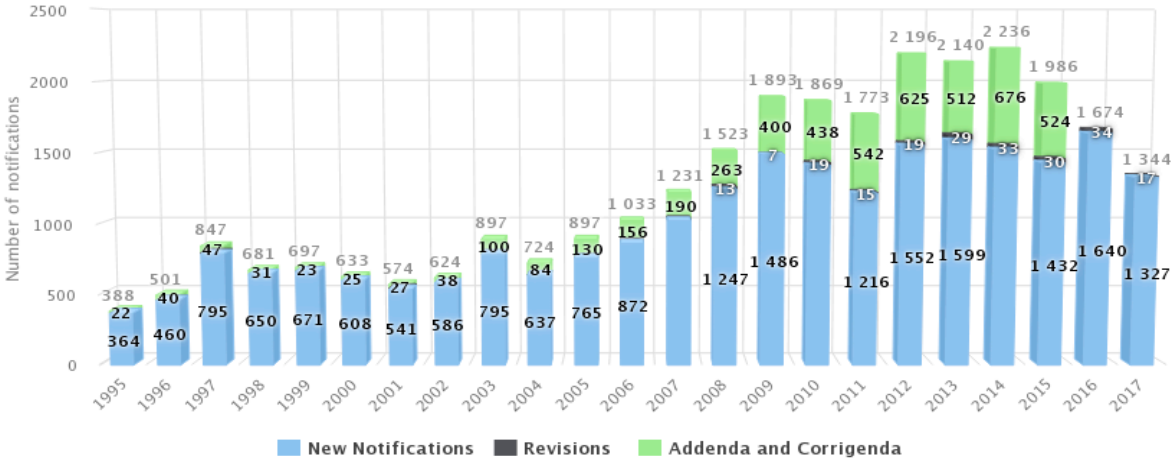

Figure 1.1: Total TBT notifications (1995-september 2017). Source: WTO TBT Information Management System (Retrieved from http://tbtims.wto.org on December 2017)

While the majority of studies find that TBTs trade are restricting, others find them to promote trade (Bao, 2014). Therefore, the quantification of the economic impacts of TBTs is the major step in trade agreement decisions (Beghin & Bureau, 2001). The rapid growth of demand on environmental amenities, food safety, and product information, oblige the implementation of TBTs in global trade. However, unlike the traditional trade barriers, the effects of TBTs are mainly indirect (Roberts et al., 1999). Consequently, TBTs are more appealing to researchers than other categories of NTBs (Calvin & Krissoff, 1998; Robrts et al., 1999; Liu and Yue, 2009).

TBTs take various forms, including technical regulations, standards and conformity assessment procedures. Over the last three decades, regulations on health, safety, consumer protection, protection of environment and animal have been dramatically increase. Meanwhile, the rise in consumers' environment concerns and welfare state has increased the demand for such regulations (Trebilcock and Pue, 2015). To respond to this demand, regulations became more difficult in some countries in an effort to protect a country’s own citizens, yet it also lead to issue

regulations and standards which may have impeded the international trade (Coglianese et al., 2014). Noting that a choice between welfare at the national level and a commitment to globalization at the international level may create conflicts for policy makers. Policy makers should prioritize their choices in order to come to the best strategy to find a balance between social welfare and economic impacts of TBTs (Kingdon, 2003). For example, one of the most famous standards that has a tendency to become a technical barrier to trade on is ecolabelling (Shams, 1995).

Growing concerns regarding environmentally friendly activities have created a large demand for environmental and safety measures. The main objectives of ecolabelling are "to raise consumer awareness about the environmental effects of products, to inform consumers about the environmental characteristics of a produc,t and to promote the adoption of more environmentally sound production methods and technologies" (UNEP, 1997). However, evidence from the academic literature shows that not all ecolabelling programs are consistent with these objectives.[2] The implementation of ecolabels and ecolabelling programs needs substantial investments such as training specialists, upgrading processes and purchasing equipment. Although ecolabelling is optional, it carries some characteristics of technical barriers to trade (TBT). There are some discussions among World Trade Organization (WTO) members that ecolabelling should fall into Trade-Related Environmental Measures (TREMs) and that the regulations in the WTO TBT Agreement should be applied to them. Also, welfare returns to investments in ecolabelling, and its success in terms of environmental protection depend on how firms would take up ecolabelling certifications and consumer demands for ecolabelled products.

The growth of environmental activities over the past few decades resulted in an increase in ecolabelling organizations (ELOs) engaged in environmental certifications and ecolabelling programs (Delmas et al., 2013). ELOs are non-governmental institutions that establish a set of standards and rules of conduct to guide companies in the application of ecolabelling and the offering of ecolabelling programs. In fact, ecolabels are certified by third parties. The third party can be a governmental or a non-governmental organization (Dauvergne & Lister, 2010);

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[2] Report of the Governing Council of the United Nations Environment Programme (UNEP), supplement No. 25, April 1997

however, ELOs are not the only parties involved in conducting and operating ecolabelling standards. Civil society groups, industry associations, corporations and hybrid public-private organizations were also created in order to control ecolabelling standards (Ven, 2015). Hence, this diversity and the lack of a universal monitoring authority may create some major problems in terms of credibility and rigor. Table 1-1 shows some examples of such ELOs across the world.

Table 1.1 List of ELOs- Selective

ELO	Description	Year	Label
Nordic swan	The Nordic Ecolabel or Nordic swan is the official sustainability ecolabel for the Nordic countries	1989	
Marine Stewardship Council	The Marine Stewardship Council (MSC) is an independent non-profit organization which sets a standard for sustainable fishing	1997	
Underwritten Laboratories (UL) Environment	The Canadian EcoLogo (also known as Environmental Choice) helps you identify products and services that have been independently certified to meet strict environmental standards that reflect their entire life cycle — from manufacturing to disposal	1988	
Forest Stewardship Council	The Forest Stewardship Council (FSC) is an international non-profit, multi-stakeholder organization that promotes responsible management of the world's forest. The FSC does this by setting standards on forest product, along with certifying and labeling them as eco-friendly.	1993	

Table 1.2 List of ELOs- Selective (cont'd)

KRAV	KRAV is a Swedish organization that develops and maintains regulations for ecological sustainable agriculture. KRAV is a member of International Federation of Organic Agriculture Movements	1985	
EKOenergy	EKOenergy is an ecolabel for electricity. It is a not-for-profit initiative of the EKOenergy Network, a group of more than 40 environmental organizations from 30 countries	2013	

Sources: Office of Consumers affairs (Retrieved from https://www.ic.gc.ca on December 2017) and Ecolabel Index (retrieved from www.ecolabelindex.com on December 2017)

This dissertation aims to explore the trade impacts of NTBs and TBTs on international trade. The first research question asks, at what probability do firms rate Non-Tariff Barriers (NTBs) as severe barriers to exports, in particular the firms in the developing and least developed countries. The reason for electing these groups of countries is that the literature presents severe challenges in developing and least developed countries. This question is addressed through in-depth analysis of data collected through World Bank Enterprise Surveys. The second question evaluates the impacts of various categories of the TBTs on the imports from the USA and China to the EU, in agricultural versus industrial sectors. To answer this question, a unique database including TBT notifications was created. The database also categorizes the TBT notifications upon the primary objectives and sectors. The question is answered by in-depth multiple case studies analysis aimed at evaluating impacts of TBTs on countries from various levels of development. The third research question is on the impacts of un-harmonized ecolabelling regulations as a TBT on trade. The question is addressed by comparing the export volume of countries holding different ecolabelling programs, considering their engagement in trade agreements and ecolabelling networks. The results of the three research questions contribute to the existing literature of NTBs and TBTs in international trade and globalization.

The dissertation is organized as follows: Chapter 2 reviews the prior literature on definition and classifications of TBTs, the trade impacts of TBTs in developed countries versus un-developed

countries, the trade impacts of TBTs in agricultural sectors versus manufacturing sectors, the eliminating approaches, and quantification approaches of TBTs, Chapter 3 addresses the research methodology including the problem statement and research questions, research methods, research contributions and research framework; Chapter 4 presents a firm-level analysis of non-tariff barriers' categories based on the importance of exports for domestic firms across diverse regions in the world (article1); Chapter 5 compares trade impacts of TBTs two case studies (countries of China and the USA), differentiated by categories, sectors and levels of development (article 2); Chapter 6 explores the trade impacts of ecolabelling regulations in combination with the harmonization approaches on TBTs (article 3); Chapter 7 discusses the general findings; the dissertation then concludes with chapter 8 that unfolds the dissertation contributions, recommendations for practical implications, limitations of the present research and recommendations for future research.

CHAPTER 2 LITERATURE REVIEW

This chapter intends to address the impacts of NTBs, TBTs, and ecolabelling in the existing literature. We analyze all the documents retrieved from our systematic review in order to answer the following review question: to what extent do NTBs and TBTs impede international trade? This chapter first provides a definition and classification on NTBs and TBTs. Further, we discuss the impacts of trade agreements which contain divisions on TBTs and also the approaches on eliminating the trade barriers of TBTs. In addition, we reviewed the approaches to measuring trade impacts of TBTs. Finally, we provide a literature review on ecolabelling as an example of regulations along with the harmonization strategies on eliminating barriers created by ecolabelling regulations.

2.1 Non-Tariffs Barriers

Proponents of globalization establish a positive association of trade globalization and the state of welfare (Cameron, 1987; Rodrick, 1998). For example, the liberalization of financial markets, that significantly improves the development of political freedom and democracy (Maxfield, 1998). However, Globalization is a commercial, rather than a political phenomenon, which is driven by currency traders and entrepreneurs rather than by politicians and bureaucrats. Globalization brings down political, social, and economic barriers (Micklethwait and Wooldridge, 2008). Trade with no barrier is an important approach to globalization.

By contrast, there are arguments among researchers of different disciplines against globalization. For instance, there is an argument among social and political researchers that suggests free trade creates negative impacts such as, among other things, increasing of unemployment and economic instability in out-zone countries (Goldsmith, 1995; Daly, 1996). Another argument against globalization is that free trade is a zero-sum game. Dagon (2010) in his article, “Liberalization in international trade”, argues that free trade may have positive impacts on the welfare of people in one place (or country), while it decreases the welfare of people in another place (or country). Therefore, the ongoing trade liberalization among countries display a zero-sum picture. There is empirical evidence supporting both side of the globalization argument.

From the perspective of international trade, globalization is defined by a reduction in barriers (tariff and non-tariff) on trade (Ethier, 2005). Traditional barriers, like tariffs, have been

undergoing a process of elimination under trade globalization policies over the past few decades. Thus, Non-Tariff Barriers to Trade (NTBs) have gradually replaced traditional barriers to trade. As Baldwin (1970) says, “The lowering of tariffs has, in effect, been like draining a swamp. The lower water level has revealed all the snags and stumps of non-tariff barriers that still have to be cleared away.” Wallner (1998) considered this phenomenon a “law of constant protection,” referring to perfect substitutability between tariff and NTBs in maintaining a degree of desired domestic protection (Bao and Qui, 2010).

NTBs are barriers that impede trade, however, they do not function in the usual form of a tariff. While the elimination of tariffs is relatively straightforward, reducing NTBs is not as simple a process as that of tariffs (Egger et al., 2014). NTBs are mainly the result of different measures taken by governments and authorities in the form of government laws, regulations, policies, conditions, restrictions or specific requirements, and private sector business practices, or prohibitions that protect the domestic industries from foreign competition (UNCTAD, 2013). Moreover, NTBs include unjustified applications of Non-Tariff Measures (NTMs). Hillman (1991) defines NTBs as those NTMs which directly impede the importation of goods into a country. Furthermore, NTBs are discriminatory because they do not apply equally to domestic and foreign products or suppliers. Recently, traditional NTBs have been replaced by new forms, such as technical barriers to trade (TBT) and Sanitary and Phyto-Sanitary (SPS) measures (Imbruno, 2016).

Besides the restrictive trade impacts of NTBs, they nevertheless have welfare-improving impacts on consumers. Indeed, NTBs provide additional indormation which clarify the charectristics of products, for the consumers, and therefore allow overcoming imperfect or deceptive information (Disdier et al., 2008; Movchan and Shportyuk, 2008). Hence, its dual nature has created some confusion in identifying NTBs (or NTMs) as barriers or not. The assumption is that when the regulations and measures create hindrances, they are considered trade barriers. When an exporting firm rates a regulation or procedure as a severe obstacle, it means that it hardly hinders its exports.

In addition, dealing with the NTBs varies among countries at differing levels of development (Gandal and Shy, 1998). The cost of non-tariff measures for developing and least developed countries, bound to their weak domestic infrastructures, is higher than high-income countries.

Expenses such as training specialists, establishing required systems, obtaining a license or a permit, etc., create disadvantages which hinder competitive capacity in international trade.

On the contrary, the majority of related previous studies focus on the impacts of NTBs on international trade from country and sectors' perspectives. The researchers compared the impacts of NTBs either among countries from different levels of development, or among various sectors (Roberts, 1998; Maur and Shepherd, 2010; Bao & Qiu, 2012).

There are various classifications of non-tariff barriers. Some scholars divide NTBs into internal taxes, health and sanitary regulations, government policies, and administrative barriers (Carrère & De Melo, 2011). Others classify NTBs into categories such as: charges on importers, customs, administrative procedures, Sanitary and Phytosanitary measure (SPS), and Technical Barriers to Trade (TBTs) (WTO annual report, 2011).

Among different categories of NTBs, TBTs are considered as the most challenging measures to be determined (Deardorff & Stern, 1998). Indeed, the challenge makes them more appealing to researchers (Calvin & Krissoff, 1998; Roberts, 1999; Liu, 2009). Quantification of economic and trade impacts of technical regulations and standard measures is the major step in trade agreement decisions (Beghin & Bureau, 2001). Moreover, in the recent years, the rapid growth of demand for environmental amenities, food safety, and product information, have increasingly imposed TBTs on global exchange.

2.2 TBTs definition and classification

2.2.1 TBTs definition

Traditionally TBTs are composed of two main categories: 1) technical regulations, including regulations that involve health, sanitary, animal welfare, environment, and 2) quality standards, such as safety, industrial, packaging and labeling standards (Deardorff & Stern, 1998; Messerlin and Zarrouk, 2000). Technical regulations are issued by policymakers and they are mandatory in international trades. Meanwhile, the standards, which mainly are issued to prevent parallel testing processes, are not obligatory (Bao & Qui, 2012).

According to the WTO TBT agreement technical regulations are documents that lay down product characteristics or their related processes and production methods, including the

applicable administrative provisions, with which compliance is mandatory. It may also include or deal exclusively with terminology, symbols, packaging, marking or labeling requirements as they apply to a product, process or production method.[3] As the WTO TBT Agreement outlines, standards are documents that are approved by recognized bodies which provide, for common and repeated use, rules, guidelines or characteristics for products or related processes and production methods, with which compliance is not mandatory.

The TBT will appear when technical regulation, standards, testing and certification procedures create obstacles and limitations to trade. The expense of compliance of technical regulations and product standards is significantly high, especially for lower income countries, because of expensive infrastructure and export services (WTO, 2012). In other words, the implementation of technical regulations and standards may dictate an extra producing cost (Otsuki et al., 1999; Siyakiya, 2017). These costs can be due to the translation of foreign regulations, the hiring of technical experts to explain foreign regulations, and the adjustment of production facilities, all of which can create obstacles to enter international trade for manufactures. However, the trade impacts vary between countries and sectors, which we discuss in the following sections of this dissertation.

The impacts TBTs can have manifest in two form: welfare and trade. Desirably, technical regulations and standards are for a range of reasons, from environmental protection, safety, national security to consumer information, and moreover, they can help trade (welfare impacts). According to WTO, welfare objectives supported by technical regulation include: "protection of human and heath", "prevention of deceptive practices and consumer protection", "protection of the environment", "quality requirements", "consumer information, labelling" and so on. An example of trade impact is when an importing country abuses the technical regulations in order to restrict the import products either to protect the domestic products or to protect the welfare of its residents (Bao and Qiu, 2010). The duality of TBTs' impacts thus complicates the answer to the question of whether TBTs tend to reduce trade by increasing the compliances cost or expand

[3] Agreement on Technical Barriers to Trade, article 2 (adoption and application of technical regulation by central government bodies) and article 3 (preparation, adoption and application of technical regulation by local government bodies and non-governmental bodies. Accessible on http://www.wto.org

trade by increasing the consumer confidence in safety and quality of imported products (Maskus et al., 2000). Therefore, TBTs are considered the most difficult and complicated NTBs to study (Deardorff, 1997).

The costly implementation of TBTs is another factor that differentiates them from other NTBs. Technical standards measures have a fixed-cost component aspect that makes them different from tariffs (Maskus et al., 2000). For instance, adapting a product to new technical standards needs an investment in the structures of export firms. As it is stated in WTO Agreement on TBTs, implementation of international standards by exporters and importers is supposed to improve social welfare through increasing trade, while in reality it is harmful in reality and thus more obvious when compared to national standards (Swann et al., 1996; Ferrantino, 2012).

The expense of TBT implementation creates additional “fixed-cost” on the producing chain. The fixed-cost includes the redesigning of a product (partly or completely), setting up a new production process, laboratory tests and global certifications, etc. Meanwhile, the standards compliance increases the "variable costs" (Maur & Shepherd, 2010). In cases where new producing processes requires more expensive raw materials, or pricey machinery, the variable costs of the product will increase. In addition, some products need extra inspections or certifications in order to meet the standards. However, some scholars believe that technical regulations and standards compliance can appear as an economic growth source. As Rodrik (2003) mentions in his book; “Institutions that provide dependable property rights, manage conflict, maintain law and order, and align economic incentives with social costs and benefits are the foundation of long-term growth.”

Policy makers try to reduce the burdensome aspect of TBTs. Activities such as creating regional agencies for metrology, accreditation, standardization, conformity assistance and technical assistance are appropriate approaches to reducing the burdensome impact of standards adoption, particularly in low-income economies (Maur & Shepherd, 2010). For example, the World Trade Organization established a technical assistance provision to facilitate standard implementation process in low-income countries (WTO, annual report, 2012). Furthermore, in section 6 (article 2), we analyze the efficiency of such approaches on eliminating the negative trade impacts of ecolabelling regulations (an example of TBTs).

2.2.2 Classification of TBTs

There are several classifications of TBTs. WTO TBT Agreement defines a classification which categorizes the TBT notifications by their objectives.[4] The categories are: "protection of human and heath", "prevention of deceptive practices and consumer protection", "protection of the environment", "quality requirements", "consumer information, labelling" and so on (WTO TBT Agreement). However, the number of issued TBT notifications under each objective varies significantly. For example, category of "protection of human health or safety" contains 8144 notifications (by December 31st of 2016) versus the issued notification under category of "Protection of animal or plant life or health" is 329 (by December 31st of 2016) – see figure 2-1.

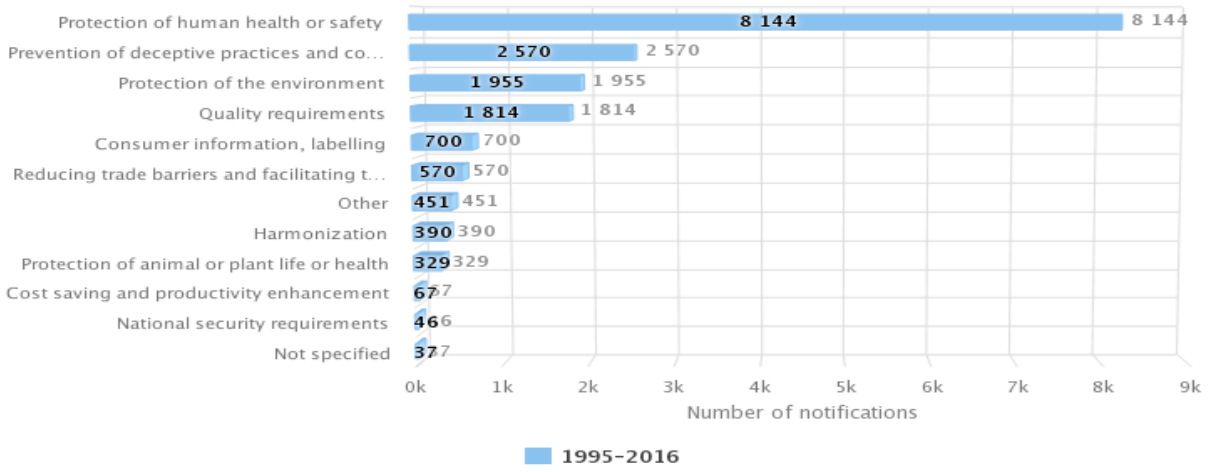

Figure 2.1: Notifications by objectives (1995-2016). Source: WTO TBT Information Management System (Retrieved from http://tbtims.wto.org on December 2017).

Roberts et al. (1999) classified TBTs through different dimensions like 1) policy instruments, 2) scope of measure, and 3) regulatory goals. Bellow, we provide an overview on these classifications.

[4] Technical regulations are submitted by WTO member countries and after verification by WTO TBT Committee would be issued as TBT notifications

2.2.2.1 Classification of TBTs by Policy Instruments (PI)

In order to correct perceived market failure, governments apply policy Instruments. Under policy instrument, TBTs are classified into three groups: 1) Import Bans, 2) Technical specification, and 3) Information remedies. In this typology, although information remedies have the smallest share compared to the other government regulations, they make remarkable conflicts among exporters. Various labeling requirements among countries lead to obstacles to entry to their market. In other words, a specific labeling requirement may not be sufficient for another country, hence additional cost imposed on producers and exporting countries.

Import bans are the major category of technical measures. Depending on the severity of the situation, the total or partial ban would be applied on importing products. For example, if current detection technology cannot recognize specific hazardous products, a total import ban (which is the most restrictive sort of technical barrier adopted to protect crops, herds and/or native species from foreign disease) would be issued. A recent example of total import bans, called “Kremlin” is the sanctions of pork and shrimp exports, imposed by Russia in 2014. It has been estimated that the sanction costs Canadian exporters about $600-million per year (Jang and Wingrove, 2014). On the Russian side, an income loss of about €3,4 billion was predicted for Russia (Boulanger et al., 2016). Partial bans are issued seasonal or regional and do not entirely prohibit entry of a given product from the exporting country.

The second group includes the technical regulations that stipulate the requirements that exported products have to meet in order to be eligible to arrive at the foreign market (destination market). In addition, technical specifications include process standards and product standards. The implementation of standards (process and product) may be found costly for some exporting firms.

Table 2.1: Classification of TBTs by policy instruments

Policy Instrument
Imports bans: *adopted measure to eliminate the associated risk of a product*
Total bans i.e. horticultural products from a country with large and widely distributed fruit fly populations
Partial bans i.e. imports of certain horticultural products for part of the year
Technical Specifications
Process standards: related regulation to process of producing, including input and technology
Product standards: end related regulations
Packaging standards: Packaging regulation including size, material, and container attribute
Information remedies: *regulations to correct the market failure stem of information failure*
Labeling requirements
Controls on voluntary claims

Source: Roberts et al. (1999)

The third group in PI classification includes the information remedies. Regulations on packaging standards, labeling requirements and controls on voluntary claims are in this group of remedies. The problem arises when the packaging and labeling regulations vary among the countries (non-harmonized). For example, the programs on voluntary ecolabelling standards are not harmonized (Hall et al., 2015).

2.2.2.2 Classification of TBTs by Scope of Measure

Another important impact of TBTs is the additional so called compliance cost that they impose on products. The compliance cost leads to additional cost on the domestic market. Hence, the price of a new technical regulation or standard would shift the demand curve in domestic markets (if the new regulation is different from international regulation). Uniform technical measures are regulations applied to domestic and foreign products, Border (Universal) technical measures are just applicable on imported goods (not domestics). Sometimes these import regulations include just the specific categories in sources that embed them in Border (specific) technical measures. Table 2-2 suggests classification by scope of measures (proposed by Roberts et al. (1999)). The additional cost of product leads to a competition advantage between importing and exporting countries.

Table 2.2: TBTs classification by measures

	Uniforms	Border (Universal)	Border (dpecific)
Measures directly affects			
Domestic Production	YES	NO	NO
Imports	YES	YES	SOME

Source: Roberts et al. (1999)

2.2.2.1 Classification of TBTs by Regulatory goals

Technical regulations may be categorized as welfare-enhancing or welfare-reducing TBTs. Regarding the impacts of TBTs on supply and demand, Roberts et al. (1999) categorized them into three main groups. Note that WTO approach on classification of TBT notifications in TBT agreement is based on the regulatory goal.

Table 2.3: TBTs classification by regulatory goals

Social Interests	Risk-reducing Measures	Non-risk Reducing Measures
Producers/Processors	Commercial animal and plant health protection	Compatibility
Consumers	Food Safety	Quality attributes
Natural Environment	Protection of natural environment	Conservation

Source: Roberts et al. (1999)

The social interest group points out the social objective of technical regulations and standards. These objectives are: protecting the economic interests of the producer, protecting the benefits of the customer, and protecting the environment. Environmental measures are regulations and standards that are more concerned with pollution-intensive products in international trade (Otsuki et al., 2001). The impact of environmental regulations varies in different sectors and countries. Some scholars suggest severe trade impacts among developing and developed countries compared to trade impacts among developed countries (Ederington et al., 2005; Bao and Qiu, 2010). Moreover, Fontagné et al. (2005) show that trade of fresh and processed foods decreased between developing and least-developed countries, while the impact of environmental measures

was insignificant and trade-improving in the majority of manufacturing sectors in almost all countries. After WTO TBT agreement came into force, many of the environment measures recognized as technical barrier to trade. For example, the environmental regulation issued by European Communities on trade description of "Sardines" (EC-Sardines Dispute) violated the WTO TBT Agreement (Mavroidis, 2013). [5]

The risk-reducing regulations are issued in order to eliminate or reduce the associated risks (e.g. outbreak of plant or animal disease) of imported products (Maskus et al., 2000). It is hard to find a regulation that excises all the importing risks, but it may reduce the risk of importing a disease. The risk-reduction measures increase products demand in destination markets (James and Anderson, 1998). However, the literature addresses some negative impacts of risk-reducing regulations on exports. Maskus et al. (2000) provide an overview on standards (including the risk-reducing regulations and standards) and their impact on trade. They found that the reaction to such regulations vary among countries. For example, Egyptian and Moroccan exporters might respond differently to a regulation imposed by the UK. Alternatively, the response of an exporting firm in Egypt to a regulation imposed by the UK might be different to one imposed by Germany.

2.3 TBTs in global perspective

The growth of TBT notifications has been highlighted in recent discussions among TBT WTO committee members. The committee reported 23,023 regular technical measures with another 6,408 addenda, corrigenda, and supplement notifications, by end of September 2017. Recently, the share of non-developed countries, including developing countries and least-developed countries (LDCs), in issuing TBTs has exceeded the share of developed countries. The TBT notifications issued by developed countries in 2016 is 407, versus 1,424 issued TBT notifications by developing countries and least developed countries (LDCs) (the share is 77% versus 23%).

[5] European Communities– Trade Description of Sardines, DS231 [EC – Sardines]

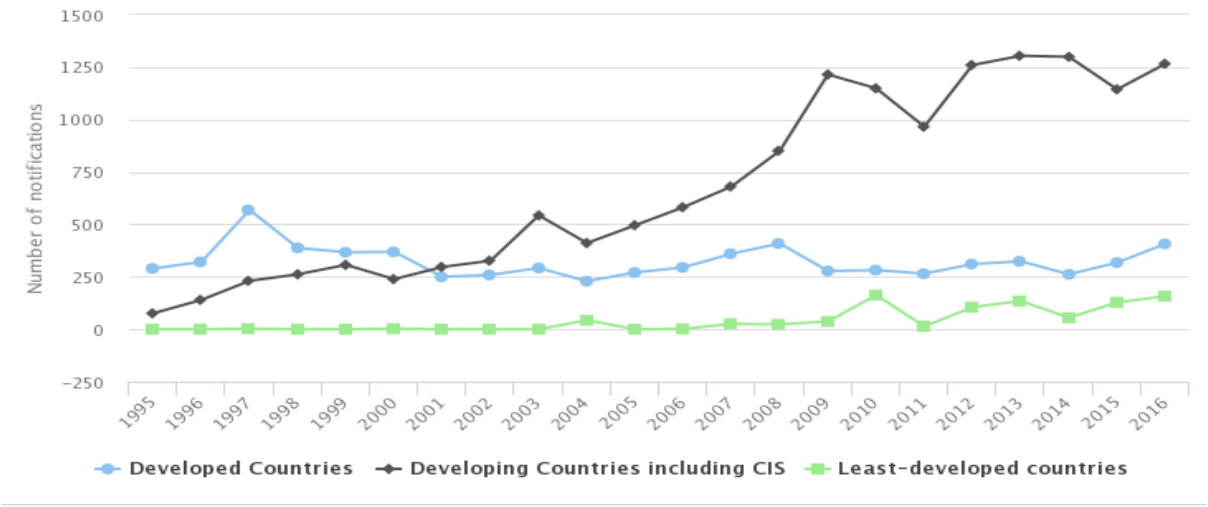

Figure 2.2: New notifications by development stature, 1995-2016. Source: WTO TBT Information Management System (Retrieved from http://tbtims.wto.org on December 2017)

To our knowledge, the previous studies mostly focused on TBTs restricting or promoting impacts on trade, and the majority concluded that TBTs carry restrictive impacts on the international trade (Bao and Qiu, 2010). The implementation of TBTs sometime adds costs specially to developing countries in comparison to developed countries (Maskus et al., 2013). The cost makes the exportation less competitive in the international market (Siyakiya, 2017). For example, Maskus et al. (2013) studied the impact on production costs of firms in developing countries from conforming to technical regulations imposed by major importing countries. They used the firm-level data from 16 developing countries. The result shows that the standards increase variable production costs by requiring additional labor and capital. They concluded that the impacts of cost could be an important determinant of export success for firms in developing countries.

Sometimes the importing countries impose additional costs on exporting countries, by requiring regulations and standards for imported products. Although the regulations may be legitimate, they potentially create some conflicts between choosing national or foreign suppliers, or among several foreign suppliers (Maur & Shepherd, 2010). The competition between domestic and foreign suppliers generates a form of domestic protection for countries, as well as a disadvantage in exporting decisions. Some scholars identify the dual impacts of TBTs on trade. First, the TBTs impose expenses on exporters by obliging them to adapt technical regulations and standards for specific markets (cost effect), second, the TBTs reduce the cost of providing and collecting

information for exporters as they provide information on product characteristics (informational effect) (Portugal-Perez and Reyes, 2010)

The impact of TBTs significantly vary across countries with different levels of developments. For example, Disdier et al. (2008) analyze the trade impacts of TBT notifications issued under TBT/SPS Agreements, on bilateral trade flows. The results suggest that the exports of Organization for Economic Co-operation and Development (OECD) have not been affected while the export from developing and least developed countries is negatively treated by SPS & TBT notification. Technical regulations have significant negative impacts on exportation from developing and least developed countries towards OECD countries.

TBTs are also have been studied in relation to the compliance cost. Compliance cost of a new TBT for developing countries and LDCs might take more time than that of developed countries. For example, in the WTO TBT Committee meeting held on 18 September 2012, South African countries demanded more time to adopt the new labeling regulation on wine. Since Europe is the main market for African wine, issuing this new TBT created serious obstacles to African wine producers (and exporters). According to the reports of this meeting; "The 30 June 2012 deadline was problematic for South African producers because the 2012 wine harvest had already been completed in the southern hemisphere and labeling had already commenced. Furthermore, consignments of wine could take over a month to ship from South Africa to Europe." Similarly, the cost of standard compliance varies sector by sector (Moenius, 2004; Maskus et al., 2013).

In addition, there is evidence of positive trade impacts of TBTs. To compare the trade impacts through the various levels of development and countries, we divide the literature in two categories depending on the level of development: 1) developed, and 2) developing and least developed countries.

2.3.1 TBTs in developed countries

The existing literature on TBTs for developed countries shows both positive and negative impacts on trade. Research began in the 1990s with Swann et al. (1996), who studied the national and international standards for UK and Germany over the period between 1985-1991. They found that shared standards had positive impacts on exports with little influence on imports, but the unilateral standards had positive impacts on imports and negative impacts on exports. Later,

Moenius (2004) examined the 12 OECD countries over the period of 1985-1995. He finds that the bilaterally shared standards are favorable to trade for both importing and exporting countries.

Bao and Qiu (2012) estimate the trade impacts of TBTs based on all TBT notifications from 105 WTO countries during the period between 1995-2008. The results show that first, a TBTs that are issued by a developed country have significant effects on the exports from both developed and developing countries. Second, TBTs that are issued by a developing country has a significant effect on the exports from other developing countries, but no significant effect on the exports of developed countries. And third, exports from developed countries are effected more seriously by TBTs that are issued by a developed country rather than TBTs that are issued by a developing country. The results demonstrate that the impacts of TBTs vary across countries.

Moreover, the literature addresses restrictions on access to the market by developed countries. For example, a study by Zhang and Lu (2002) on exports of China to the EU and the USA shows that TBTs created obstacles to 71% of total Chinese corporations with 39% of total exports. Another example is access to the EU market. Hu et al. (2017) investigated the performance of Chinese firms, which export cigarette lighters to the EU between the years of 2004-2008. In fact, they were looking for the results of adopting the "Children-Resistant" (CR) act in the EU. The results shows that firms adjust their product quality to meet the CR act and upgrade their product quality in other dimensions. However, the export value and volume to the EU decreased.

In addition, some evidence shows negative trade impacts of TBTs on exportation of developed countries to developing countries. For example, Sumner and Lee (1995) studied the impacts Asian import regulations face U.S. vegetables. The result shows that the regulations impose additional cost at different points of the market chain, which consequently impacts foreign exchange flows. Note that this study belongs to the period before WTO TBT committee restrictions which issued TBTs that are discriminatory toward trade.

Although the trend of issuing TBT notifications by developing countries exceeds the ones by developed countries (see figure 2-3), still in 2016, the US (a developed country) is the most active nation in presenting TBTs to WTO TBT committee (almost 11.7% of the total TBT notification).

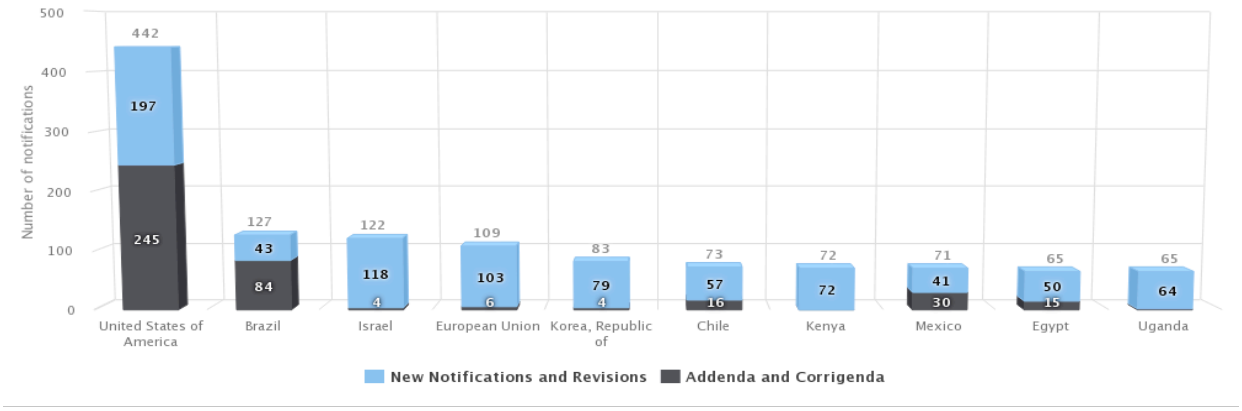

Figure 2.3: Most active notifying members (2016). Source: WTO TBT Information Management System (Retrieved from http://tbtims.wto.org on December 2017)

2.3.2 TBTs in developing and least developed countries

Developing countries and LDCs are typically more "standard takers" rather than "standard makers." Even if an importing country's standards apply to all export countries without discrimination, different export countries still face different compliance costs because of their different productivities and resource conditions. In this sense, TBTs are of particular concern to developing countries, where the production infrastructure lags far behind that of developed countries. Moreover, the lack of access to information, technology, expertise and finance might limit their capabilities in meeting the requirement regulations imposed by developed countries (Bao, 2014).

The cost of adopting technical regulations and standards for non-developed countries, regarding the weak domestic infrastructure, is higher than the cost in developed countries. Expenses such as training specialists, establishing required systems, purchasing equipment, etc. create obstacles to participating in the trade market. For example, Hungary and Mexico, in the 1990s, spent a large fund to apply the regulations of developed countries. They spent more than 40 million dollars to improve its industrial structure, and Mexico spent around 30 million dollars to meet the requirements of regulations in intellectual property laws (Finger, 1999).

One of the main concerns of developing countries and LDCs is the growth of technical regulations and standards, especially the ones that are issued by developed countries (Messerlin and Zarrouk, 2000). There are some notes in UNCTAD (1999) that developing countries were arguing about their special development needs and technological problems, and that they are afraid of losing the competence in the global market. Furthermore, studies about trade impacts of TBTs on developed countries versus non-developed countries support this argument. Following are some examples from incremental literature.

Maskus et al. (2005) use firm-level data of 16 developing countries collected from the World Bank's TBT survey database. They found that TBTs impose production costs by requiring additional inputs of labor and capital. They also mention that the fixed cost of compliance are non-trivial; approximately $425,000 per firm, or about 4.7 percent of value added on average. Both production and fixed cost are significant. Further, Disdier, Fontagné, and Mimouni (2008) estimate the trade impacts of NTBs, including the TBTs and standards, on 690 agri-food products (HS6-digit level) on OECD members as importing countries versus 114 exporting countries in 2004. They find that TBTs do not significantly affect the exports among OECD countries but the exports from developing countries and LDCs are negatively affected. However, the result was not similar to the prior research by Fontagné, Mimouni, and Pasteels (2005), in which they cover the NTBs, including TBTs on 61 exporting countries and 114 importing countries, in 2001. They found that LDCs, developing countries, and OECD countries seem to be similarly affected. However, agri-food exporters of OECD tend to benefit from NTBs other than exporters of developing countries and LCDs.

Later, Bao (2014) studies the trade impacts of TBTs issued by China on Chinese imports. The empirical analysis is based on a sample covering China's import control measures (TBT, tariff, license, and quota) during the period of 1998-2006. The results show that TBTs reduce the probability of imports from China with potential trade partners and meanwhile increase the imports' values with existing trade partners. Ferro et al. (2015) study the impacts of standards and regulations on 61 importing countries and 66 different agricultural products. The results suggest that exports from developing countries are constrained particularly by stricter standards. In addition, Otsuki et al. (2001), Lacovone (2005) support the negative trade impacts of TBT that are imposed by the EU, on exporters from developing countries.

2.4 TBTs in sector perspective: agricultural versus industrial

By September 2017, the TBTs number of notifications issued in agricultural (non-manufacturing) and industrial (manufacturing) sectors are respectfully 2017 and 7442 regular notifications. Despite the smaller number of notifications in agriculture, the literature shows higher trade impact of TBTs in this sector. For example, Fontagné, Mimouni, and Pasteels (2005) collect the data on 61 product groups in 2001. The founding indicates that NTBs, including TBTs, have a negative impact on trade of agri-food but do not have significant impact on trade of majority of manufacturing products (an insignificant or even positive). Yoon et al. (2014) analyzed a sample of 30 WTO members that are importing from South Korea, and also have the highest number of issued TBT notifications on period of 2002-2010. They found that TBTs discourage exports in agricultural sectors while promote exports in manufacturing sectors.

Following are examples from the literature in both sectors of agriculture and industry. Beside the studies that compare the trade in two sectors with each other, there other studies that analyze the trade impacts of particular standards or particular products. We collect some examples on each industry to provide a clear comparison between trade impacts of TBTs in agricultural and industrial sectors.

2.4.1 Agricultural sectors

Technical barriers to trade exist in most industries, but are particularly important in the international exchange of agricultural products (Roberts et al., 1999). The earlier literature about TBTs in agricultural sectors goes back to 1990s. Sumner and Lee (1995) developed a model that showcases the difficulties facing U.S. vegetables du to Asian imports regulations. They found that the regulations impose cost at different points of the market chain, that consequently impacts foreign and domestic prices as well as foreign exchange flows. They also suggest a shift in the supply and demand curves for the U.S. vegetables in Asia. Later, Orden and Romano (1996) studied the imports of avocados from Mexico to the U.S. (referring to the U.S. ban on avocado from Mexico). They found that removing the ban had combination effect of trade gain (from cheaper avocados) and resource losses (the cost of producing avocado domestically in the U.S.). They also suggest that domestic supply shifts when there is no ban on importation of Mexican avocados.

Further, Otsuki et al. (2001) examine the trade impacts of aflatoxin standards that are set by the EU on exports of food from Africa to the EU for the period of 1989-1998. They compare the standards that are issued by the EU with those suggested by international standards in groundnuts, vegetables, fruits, cereals, and other agricultural products. The findings suggest that the implementation of the new aflatoxin standard in the EU will have a negative impact on African exports of cereals, dried fruits and nuts to Europe. They estimate the reduction of African exports is about 64% (US$ 670 million) in comparison to unified regulations. Similarly, Lacovone (2005) examines the trade impacts of the EU aflatoxin standards on imports of food from Latin America to the EU. The results showed that there is substantial decrease of exports to Latin America from tightening of these sorts of standards.

Wilson et al. (2003) examined the trade impacts of drug residue standards on trade of (hormone treated) beef. They find that international standards that are set by Codex would increase the global trade in beef by over $3.2 billion. This includes rise in exports from South African by $160 million, Brazil by $200 million, and Argentina by $300 million. Ferro et al. (2015) studied the impacts of standards and regulations on 61 importing countries and 66 different agricultural products. The data set used import markets' maximum residual limits of pesticides, which covered 243 agriculture products. The analysis finds that the effects of standards on trade intensity in most cases are indistinguishable from zero.

Further, Krishnan (2016) studied the trade impacts of NTBs (including TBTs) on exports from India for the period of 2001-2012. Through analyzing the Operational and Administrative System for Import Support (OASIS)- a database launched by U.S. Food and Drug Administration- he found that the rate of rejection of food products is very high compared to other categories like cosmetics, drugs, antibiotics, and the like.

2.4.2 Industrial sectors

Swann et al. (1996) examined the impacts of country-specific regulations and international standards that are issued by the UK and Germany, for 88 manufacturing industries, on British net exports for the period of 1985-1991. They found that the national standards of one country would be cancelled out by competing standards activities in another country. However, they concluded that international regulations and standards had positive impacts on exports of Germany.

Later, Moenius (1999 and 2003) analyzed the demand for products that implied the TBTs. Moenius (1999) finds that shared product standard between the exporting and importing countries promote the trade among a sample group of developed countries. However, the country specified standards that are imposed by the importing parties are found to be impeding trade, while the country specific standards that are imposed by the exporting parties increases trade. Moenius (2004) examined shared regulations standards for 471 industries in 12 OECD countries over the period of 1980-1995. He found that the number of regulations and standards that are issued by importing countries would restrict the imports of non-manufactured products (e.g. agriculture), and meanwhile would promote trade in manufacturing sector.

Siyakiya (2017) investigates the trade impacts of TBTs on exports of South Africa. He collects the data on all categories of products which are exported to 57 selected countries in period of 1995-2015. The result shows that TBTs impact negatively the mechanic and electrical products more than other products. He estimates the increase of one unit in the number of TBTs has an effect of reducing export volume by 4.88% on average.

2.5 TBTs in micro-level perspective

The business environment has never been so globalized, inter-dependent, and connected. Expansion of regional economic integrations, excessive liquidity in financing cross-country purchases, increasing connectedness with customers and marketing partners due to major advances in information, communication, and transportation technologies, has encouraged the enterprises to join the global market, however, a large number of smaller-sized manufacturers still do not feel strong enough to cross national boundaries to sell their products and services internationally (Leonidou, 2004).

Firms profit from globalization as well as trade liberalization. Trade liberalization promotes the average industry productivity through within-industry reallocation of resources. Average industry increases since the low-productivity firms exit and high-productivity firms enter export markets (Melitz and Redding, 2014). However, over the last two decades, a transformation placed firms, rather than countries or industries, as the main unit of analysis (Antràs et Yeaple, 2013). This section, reviews the literature on TBTs impacts on domestic or multinational firms.

The impacts of TBTs on firms vary regarding the sector of firm's activity, its product or even the country of origin (or where the firm is located). For example, the World Bank TBT survey looks at 689 firms in over 20 sectors in 17 developing countries. The result shows that 70% of the firms report that they face TBTs in their exports market, whereby the regulations that are imposed by the EU, the U.S., Japan, Canada, and Australia, are generally considered the most important regulations by the firms surveyed. According to the survey, the firms have to invest in: additional plant or equipment, one-time product design, product redesign for each export market, additional labor for testing and certification, or lay off workers, in order to meet standards. Consequently, the cost of applying the TBTs, depends on many factors and varies among firms. The factors include, but not limited to: type of the product of the exporting firms, the regulation on agricultural sector are relatively more than the regulation on industrial sectors; trade agreements (such as FTAs, MRAs) between the country of origin and the country (or countries) of destination, common technical regulations are potentially similar and favoring the domestic industries and firms of the zone; and being member of a trade organization or union (ex. WTO, EU) through its country of origin, which makes them qualified to receive assistance in case of low development.

The implementation of non-harmonized TBTs increase the cost of producing for exporting firms. For example, a technical regulation that is issued by country x imposes an upgrading or adoption of the product or packaging. Consequently, the multi-destination firms drive their exports toward the TBT-free destination. In fact, the higher the cost of complying with the TBT, the higher the probability that exporters will divert trade towards other destination (Fontagne et al., 2016).

The heterogeneous firms have the option of diverting trade to other destinations that do not impose TBT measures (Fontagne et al., 2016). In recent literature on TBT, researchers tried to examine firms' export decisions on trade probability and trade volume under the heterogeneous firm framework (Bao, 2014). For example, Czubala et al. (2009) study the impacts of EU's technical regulations and standards on African textile and clothing export. They find that non-harmonized regulations reduce African exports of these products. Moreover, the results show that the EU standards, which are harmonized to ISO standards, are less trade restrictive.

2.6 Elimination of technical barriers to trade

The agreements on technical regulations and standards have to reduce trade impacts of TBTs, while ensuring that the expected goals (welfare objectives) would not be violated. There are three international approaches on reducing the negative TBTs' impacts on trade: harmonization, WTO TBT agreement, and the Mutual Recognition Agreements (MRAs). Note that the OECD organization was one of the first trade organizations, which recognized technical regulations. In 1972, the OECD published its Guiding Principles Concerning the International Economics Aspects of Environmental policies in which the OECD informed trade policy-makers about how to approach environmental regulations.

Following sections present a brief explanation and examples on empirical studies for each approach:

2.6.1 Harmonization on TBTs

Harmonization is a process of assimilating the domestic laws, regulations, and principals with internationals policies (Mayeda, 2004). Efforts to harmonize national regulations to international regulations, promise concrete benefits through trade expansion (Czubala et al, 2009). Harmonization improves trade among the exporting companies and firms by facilitating entry to the global market. It is enough for foreign exporters to just meet a series of technical regulations to gain access to the whole market (Maur & Shepherd, 2010). However, finding a balance point between the cost and benefit of the TBTs and harmonization has to be solved through empirical evidence.

Despite the definition of TBTs and standards harmonization, there are some studies that resulted on inefficiency of harmonization approaches. Chen and Mattoo (2008) compare the impacts of multilateral and regional trade agreements and harmonization of standards on promoting the trade (reducing the negative impacts of trade). They conclude that harmonization of standards reduces the exports of excluded countries. Xiong and Beghin (2011) provide an econometric examination of the harmonization of the EU Maximum Residues Limit (MRL) on aflatoxin in 2002, and the impacts on African exports of groundnut product. They conclude that the MRL, which is set by the EU, has no significant trade impact on groundnut exports from Africa (across various methods of estimation).

According to Maur & Shepherd (2010) harmonization happens in at least two types:

Unilateral Harmonization: when one country or a group of countries adopt another country's dominant regulation and standard.

Concerted Harmonization: when members cooperate to prepare acceptable requirements for all countries. Establishing a concerted harmonization required negotiations about every regulation and standard in each jurisdiction. More diversity among standards of countries creates more challenges on harmonization.

Concerted harmonization is more common than unilateral harmonization. Asia-Pacific Economic Cooperation (APEC) comprised of developed countries (e.g. Australia, Canada, Japan, and United States), developing countries (e.g. China, Peru, and Thailand), and transition countries (the Russia Federation and Vietnam) is an example of concerted harmonization.

De Frahan and Vancauteren (2006) examine the impacts of harmonization on European countries. They show that harmonization has a significant positive effect on bilateral trade. On average, bilateral trade in harmonized sectors is 253% higher than in non-harmonized sectors, and the tariffs equivalent of non-harmonization (depending on the sector), was from 73% to 97%. They conclude that a single harmonized standard avoids the costs of parallel testing regarding multiple standards, and facilitates producers and exporting firms to enter the global market. Although the harmonization reduces the standards expenses for insider companies, the exporters must convince the destination region of their standards compliance, and this will be added to their own previous standards from the home country. This various demands for standards, cause multiple costs for exporting firms (Maur & Shepherd, 2010).

Despite the important role of harmonization in developing countries, it seems harmonization sometimes does not have the ability to recognize the efficiency of standards and technical regulations in international affairs. There are two different debates in harmonization; first between trade globalization defendants and environmental groups, and second between developed and developing countries (Mayeda, 2004). Developed countries are not happy about international harmonization that forces them to adopt lower standards, and developing countries consider compliance with technical regulations and standards to be barriers to their exports and international trade. However, after the Uruguay Round and WTO agreements on TBT and SPS,

the strategies have been changed from eliminating technical barriers to improving the infrastructure and creating new institutions in countries that need them (Srinivasan, 2002).

2.6.2 GATT/WTO agreement

Since World War II, the GATT/WTO multilateral trade agreement, has mainly focused on the exchange of industrial goods between developed economies. However, in the last two decades less developed countries have attempted fundamental economic reforms and are struggling to become part of the multilateral system (Ethier, 2005).

GATT (1979) adopts its first agreement on TBTs, the so-called 'Standards Code', during Tokyo Round of multilateral trade negotiations. The Standards Code just ratified by only 39 countries (Wirth, 1994) and applied to all products, including agricultural and industrial products. The code introduced international harmonization of standards to ensure that technical regulations and standards would not create barriers to international trade. The Standard Code encouraged countries to bind in MRAs for test the results, certificates, and marks of conformity of each other's. Although the main line of Standard Code is that regulations and standards do not create obstacles to international trade, it has never adopted a set of criteria to differentiate between necessary and unnecessary barriers to trade (Middleton, 1980). The development and extension of Standard Code formed the objective of the Uruguay Round.

The Uruguay Round (1993) divided the Standards Code into two new agreements: Technical Barriers to Trade Agreement (TBT Agreement) and Sanitary and Phytosanitary Agreement (SPS Agreement). SPS Agreement included technical measures on protecting human, animal, and planet, and health, while TBT Agreement covers other technical measures, which do not fall in SPS Agreement. In addition, the Uruguay Round obliged all the country members to be committed to all agreement issued by GATT. Despite all these efforts, the issues on TBTs seem to be remained unsolved (Sherry, 1999).

The WTO's strategy to help relatively less developed countries is “technical assistance” provision. Both the TBT and SPS Agreements consider the technical assistance to be an important topic in their agenda (WTO annual report, 2012). The TBT Agreement highlights the obligation for members to help developing countries and LDCs to adopt the standards and technical regulation (Busch & Reinhardt, 2003).

The acceptance and participating in the WTO depends on countries' support of factors such as liberal democracies, social democracies, and centralized economies. Since there are differences among perspectives of developed, developing and least developed countries, we cannot expect the same level of motivation to follow the WTO for all nations (Mayeda, 2004). For example, Bao and Qiu (2012) estimate the trade effects of TBTs, through examining all TBT notifications issued by 105 WTO member countries from 1995 to 2008. The main results include: first, a developing country's TBT has significant effects on exports from other developing countries, but no significant effects on the exports from developed countries, second, TBTs issued by a developed country have significant effects on the exports from both types of countries, and third exports from developed countries are affected by a developed country's TBT more severely than TBTs issued by a developing country.

The 10 benefits of WTO trading system according to their annual report are presented below:[6]

1- Promoting peace

2- Handling the disputes constructively

3- Making the rules easier for all countries

4- Cutting life costs by trade liberalization

5- Raising income

6- Stimulating economic growth

7- Encouraging government to eliminate unnecessary policies

8- Making like more efficient by issuing basic principals

9- Providing more products and qualities choices

10- Protecting countries from lobbying

The technical regulations and standards are not only led by the national or governmental authorities, so the TBT Agreement applies to governmental and non-governmental, national and international organizations, and sets forth rules to them. The TBT agreement attempts to prevent

[6] World trade organization (2008), "10 benefits of the WTO trading system"

of unnecessary obstacles that may be created by standard- related measures. While complying with technical standards creates barriers to trade, the important rule of the WTO is to reduce the burden of the standards and technical regulations and eliminate the discrimination imposed on trade (Maur & Shepherd, 2010). However, not all the researches support the efficiency of the WTO approaches.

Rose (2004) provides the first econometric research on the impact of the multilateral agreements on trade. Rose studies the trade of 175 formal members over 50 years and the impacts of trade agreements on member and non-member countries. The results show that membership in WTO does not increase the trade value between the members. His findings show that participating in the GATT/WTO increases trade volume, however, finally he concludes that once the impacts of standards are included in the econometric model, being a WTO member is not an accelerator in trade. However, this result has been rejected afterwards.

Subramanian and Wei (2007) do not just reject the results of the Rose's research, but also show that GATT/WTO has a significantly positive effect on international trade. Their research represents the impacts of WTO, between developed and developing countries, new and old developing country members, and sectors. They also applied the Anderson and Wincoop (2003) version of the gravity model. They believed that TBT Agreement of WTO in terms of globalization, influences more the imports versus exports. Hence, they choose the imports as the dependent variable, which was explained by the usual indicators in international trade gravity equation (GDP, distance, common language, shared border, colonial links, etc.) and dummy variables to estimate WTO membership's effects on trade. The variable list includes almost all explanatory variables in Rose's model. Their study also shows that membership in the WTO creates almost 30 percent growth in imports. According to their study, joining the WTO could cause up to 68 percent growth in industrial country imports. However, the advantage of WTO membership for developing countries is much less than developed countries. They also mentioned that in sectors with high protection such as food, clothing, and footwear, WTO membership has no significant impact.

Tomz, Goldstein, and River (2005) study the efficiency of WTO to accelerate the trade. Applying the same methodology as Rose's, they show that GATT significantly increases the international trade of participants - official members or nonmembers – in comparison with nonparticipant

nations. They also found a significant statistically effect of GATT on trade in both developing and industrial countries. They asserted that Rose tested the GATT/WTO impacts on only formal members and he excluded 27 de facto participants; hence, he estimated a negative and insignificant impact from these organizations. They admit that some adjustment processes, concessions prior to joining the GATT, or interactions between the GATT have to be included in order to have a full structural model. Also, because of the logarithm definition the zero values of trade can be excluded from the gravity equation, which might create an underestimation about GATT/WTO impacts on international trade. Later Liu (2009) concludes that GATT/WTO has significant positive impacts on international trade. He similarly, applied a gravity model but the Poisson quasi-MLE method on Imports of formal member countries.

2.6.3 Mutual Recognition Agreements (MRAs)

Mutual Recognition Agreements (MRAs) happen where a country allows any other participants access to its market (Chen & Mattoo, 2008). The MRAs make all participant countries get treated equally through product standards, even though standards are different among countries (Maur & Shepherd, 2010).

The MRAs offer a certain degree of harmonization, which is (normally) enough to permit the entrance to the markets of other binding countries. Chen & Mattoo (2008) study the MRAs among 42 countries, including all OECD countries and 14 of the biggest exporter developing countries, in a period of 1986-2001. They focus on the impacts of standards of regional agreements on trade between MRAs member countries and what are the trade consequences of leaving the MRAs. They show that according to literature, intra-regional trade increases regarding regional harmonization, and the harmonization can create more efficient international market by reducing the fixed costs and improving transparency - but only if the common standards are not too stringent or poorly designed. Their founding, however, shows that meeting the standards is more expensive for the firms from developing members (countries) than the firms of developed members (countries).

Baller (2007) investigates trade effects of the regional liberalization of TBTs in the form of harmonization and MRAs for the testing procedures in the electronics communication and medical machinery industries between OECD members and non-members. He looks into the sectorial effects of regional TBT liberalization on members of the agreements and compares with

the excluded (non-party) developing countries. He finds that MRAs have a significant positive influence on both export probabilities and trade volume for partner countries. Interestingly, the MRAs have positive significant impacts on excluded OECD countries, but not on excluded developing countries. In other words, the MRAs do not benefit developing countries outside the region of the agreement.

Messerlin (2011) recognizes two categories of the MRAs, conditional and unconditional recognition agreement. For example, the EU approach to eliminate TBTs is conditional MRA, and the Trans-Tasman Mutual Recognition Agreement (TTMRA) subjects all products to unconditional mutual recognition (Togan, 2015). Moreover, the implementation of the MRAs regarding to their different social preferences and fundamentally different approaches toward regulations may sometimes be associated with difficulties (Maur & Shepherd, 2010). Therefore, mutual recognitions often occur among relatively similar countries (i.e. European Union).[7]

2.7 Quantification approaches of technical regulation

Beghin and Burea (2001), Maskus et al. (2001), Maskus and Wilson (2001), Ferrantino (2006), Korinek et al. (2008), Bao and Qiu (2010), and Fugazza (2013) all provided comprehensive review on key economic issues related to NTMs (including TBTs) modeling and quantifications. Among the employed methodologies, there are several quantification approaches such as, "inventory measure", "price comparison", "business survey", "quantity impacts", "gravity models", "equilibrium models (partial and general)", and "cost-benefit analysis" that are expected to be more reliable (Fugazza, 2013) to measure the trade impacts of the NTBs. However, regarding the dual nature (trade and welfare) of TBTs impacts, the quantification of welfare impacts seems to be essential.

The challenge in analyzing the impacts of TBTs is in their nature. As literature shows, the TBTs do not just impact on trade and consumption, but also on welfare. As Fugazza (2013) says that even with the simplest theoretical framework, the quantification of both economic and welfare impacts of TBTs cannot be determined. He explains that the major difference between technical

[7] Cassis de Dijon decision: products that comply with mandatory regulations in one European country cannot usually be prevented from accessing markets in other European countries (Maur & Shepherd, 2010).

regulations and non-tariffs measures is the existence of compliance cost. The compliance cost contains the fixed cost of upgrading the equipment, obtaining certificates, altering marketing strategies, and etc. In consumers' perspective, regulations and standards would signal a higher quality via information it carries. For example, labelling requirements, detailed description of certain restricted toxic residue, can be considered valuable for the consumer. As the compliance cost is called "standard barrier" the quality improvement effect referred to as "demand enhancing effect", or "standards as catalyst".

This section reviews some examples of recent literature in the field of quantification the trade impact of TBTs. The decision to select the best quantification methodology, however, depends on the research question and the accessible data. Regarding the different nature of TBTs, we also review the approaches on quantification the TBTs themselves. For more information on TBTs quantification, we suggest to read the comprehensive reviews of quantification approaches, written by Ferrantino (2006) on NTMs and SPS, and Fugazza (2013) on NTMs with focus on TBT.

2.7.1 Quantification of TBTs' trade impacts

The quantification of the TBTs' trade impacts requires specific information such as detailed knowledge about the regulations, the implied process by producers to meet the regulations, and the implementation methods. The trade impacts of TBTs have been quantified either through ex post or ex ante approaches. The ex ante approach refers to simulations with the calculation of tariff equivalents and is usually employed to predict unobserved welfare and impacts. For example, simulating a partial or general equilibrium model to estimate how consumers and producers will respond to the price change, which created by applying the TBTs (Korinek et al., 2008; Bao and Qiu, 2010). Generally, the *ex ante* strategies include but are not limited to: the qualification of tariff equivalents, measurement of demand and supply shifts, and the analysis of standard-induced market segmentations (Korinek et al., 2008).

The ex post approach includes gravity-based econometric models which are implied to calculate the observed changes in trade, while controlling for the other factors that may have an impact on trade. The most common models in ex post approach are: the gravity model and models of

individual firms' export decision. However, the examples of gravity model used for quantification of TBTs' trade impacts dominate other approaches.

The majority of scholars applied gravity model to analyze the trade impacts of NTBs (including TBTs). For example, Metha and Nambier (2005) apply the gravity model with the linear-log specification and OLS estimator; Baller (2006) uses a two-stage estimation structure. Stage 1 is a probit gravity equation yielding a proxy for the fraction of firms who decide to export; stage 2 is a standard bilateral trade gravity equation in which the fitted values from stage 1 are used to correct for the heterogeneity bias; Disdier et al. (2005 and 2007) imply a gravity model with the fixed effects for each exporting and importing countries' (multi-resistance term), and sector's specific fixed effects. Yoann et al. (2014), used a gravity model in the form of generalized two stage least squares. Bao and Qiu (2010, 2012), Siyakiya (2017), Wood et al. (2017) used various forms of gravity model in their research. However, the earlier literature shows other approaches on TBTs.

Since Tinbergen (1962) introduced the gravity equation, many questions about the impacts of mutual borders, cultural and institutional differences, the existence of an ambassador in bilateral trade, environmentally related policies, and different language and currency have been answered by applying third model (Van Bergeijk & Brakman, 2010). According to Anderson and Wincoop (2003), the general concept of gravity model is that the bilateral trade flow is positively affected by economic size, market size, and common language and negatively affected by distance and other multi resistance factors (Siyakiya, 2017). In addition, regarding limited accessibility of data on technical regulations and standards, gravity model creates a proper approach on quantifying of trade impacts (Kapuya, 2015).

Roberts et al. (1999) suggest a framework to analyze the TBTs impact on trade, which is composing of “regulatory protection”, “supply shift”, “demand shift” elements. Although his model focused on agricultural sector, it can explain the TBTs impact on all other sectors. He introduced a regulatory protection with no externalities model in an importer and exporter perspective. The TBTs impact can be presented in two perspectives: Importer country and Exporter country.

Roberts et al (1999) introduced a classification of NTBs by scope of non-tariff measures. These measures apply to all exporters (universal) or apply to one exporter (specific). Roberts et al.

(1999), in order to explain their model, include the importer perspective and their compliance expenses as well. They introduce a model, called "Regulatory Production" that presents the scope of measures for both importer and exporter approaches in two universal and specific cases. In this model, the compliance costs (of the TBTs) effect trade the same way as tariffs but without any revenue (Calvin & Krissoff, 1998). These expenses are considered a loss for importing countries and a gain for domestic producers and finally a welfare reduction for society (deadweight loss).

Table 2.4: Scope of measures, exporter and importer perspective

	Regulation imposed on one exporter (specific)	Regulation imposed on all exporters (universal)
Regulation imposed by one importer (specific)	-Avoid compliance cost by trade with another markets	Importer have to pay the compliance cost
Regulation imposed by all importers (universal)	Exporter have to pay for compliance cost in order not to lose the market	Both importers and exporters have to pay for compliance costs

Source: Roberts et al. (1999)

2.7.1.1 TBTs effects from importer perspective

Figure 2-4 presents impact of compliance cost of TBTs on welfare and trade from importer perspective. Assume the importing country with domestic producers and consumers facing the world price P_w. At this price, the quantity demanded by consumers is Q_D^1, the quantity supplied by domestic producers is Q_S^1 and the difference between Q_S^1 and Q_D^1 shows the quantity of the imports of importing country (seen as Q_S^1 - Q_D^1 in the left-hand panel and M_1 in the right-hand panel). When this importing country alone adopts a universal regulation intended to protect domestic producers, the price in the importing country increases. If this importer is the only importing country, which imposes the regulation in its market, the price of the product changes from P_w to $P_w + C$. Following the price change, the imports change to distance of Q_S^2 and Q_D^2 (seen as M_2 in right-hand panel). Consumer surplus also falls, by the area A+B+C+D, while producer

surplus increases by A. In the left-hand panel (World Market) M_1 is the import before the additional standard cost and M_2 is the imports in price $P_w + C$ and ED is the demand line. By imposing the regulation, the import shifts from M_1 to M_2 and this leads to a reduction in trade gaining equal E + F.

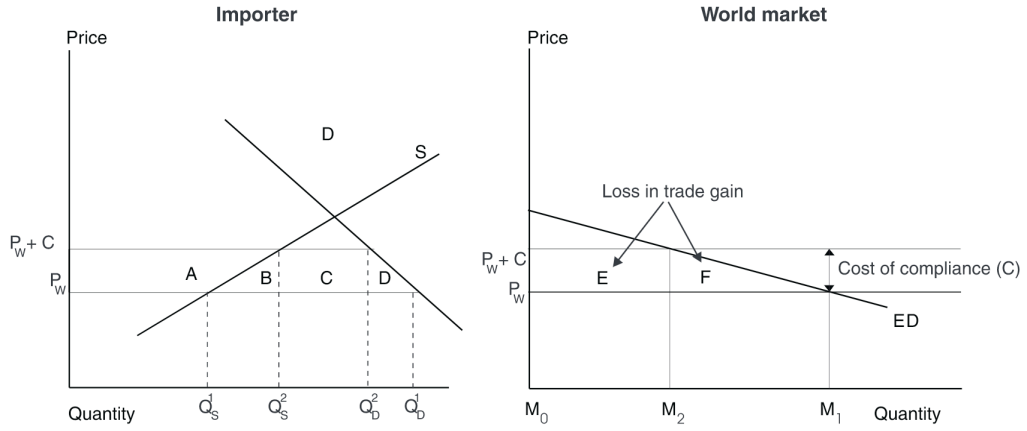

Figure 2.4: Importer perspective. Source: Roberts et al. (1999).

2.7.1.2 TBTs Effects Exporter Perspective

Figure 2-5 shows the impact of compliance cost of TBTs from exporter perspective

Importer-specific exporter-specific case

Importer (universal) exporter-specific case

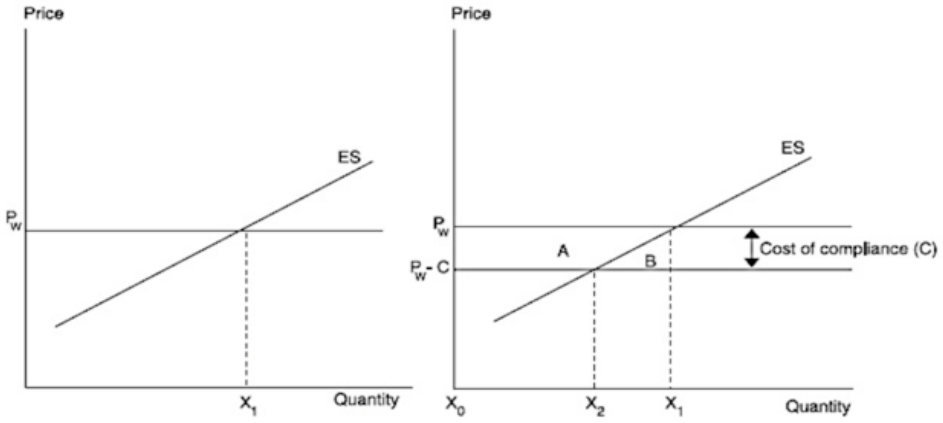

Figure 2.5: Exporter perspective. Source: Roberts et al. (1999)

In the import-specific, exporter-specific case, one importer adopts a regulation targeted at a single exporter. The exporter continues to export X_1 by shipping the product to other destinations countries. On the right-hand panel, all importers adopt a regulation that targets a single exporter, the additional compliance cost C are borne by the exporter. So the world price is in fact $P_w - C$, which lead the exporter to decrease the export from X_1 to X_2, and the gains from trade decline by area A.

There is an ongoing discussion on the advantages and disadvantages on each of these estimation approaches (Opper et al., 2004; Bao et Qiu, 2010). To select the best approach there are indicators such as: accessibility of data and objectives of measurements, to be considered (Popper et al., 2004; Bao and Qiu, 2010).

2.7.2 Quantification approaches of TBT

To calculate the trade impacts of TBT (in particular by employing the gravity model), the TBT should first be quantified. Many scholars applied the same approaches of NTMs quantifications for TBTs (for example Bao et al. (2010)). Bora et al. (2002) reviews the approaches on NTMs quantifications. These approaches are: the inventory approach, modeling approach, the tariff equivalent or price wedge, subsidy equivalent, the trade restrictiveness index, effective protection. Regarding to quantification of TBTs, literature shows 2 approaches that have been applied more frequent: counting TBT notifications, and frequency index.

Swann et al. (1996) use the available information on the data regulation by counting the number of voluntary national and international standards. They count the standards recognized by the UK and Germany as indicators of standards over the period of 1985-1991. Similarly, Moenius (2004) used the data of regulations by counting the binding standards in a given industry as a measure of stringency of standards. Following them, Siyakiya (2017), Yoon et al. (2014), Bao and Qiu (2012), and Beghin and Bureau (2001) also quantify the TBTs by the total number of TBT notifications to the WTO.

Fontagné, Mimouni, and Pasteels (2005) used a frequency index approach, and collected data on 61 product categories in 2001. They found that non-tariff measures, including standards, have a

negative impact on the agri-food trade but have an almost positive impact on most manufactured product. They also compare developed and developing countries, and concluded three of LDCs, developing country and OECD countries are affected similarly. Disdier, Fontagné, and Mimouni (2008), also used a frequency index approach, and concluded that OECD exporters are not affected by TBT in their exports to other OECD countries, but TBTs affect negatively on the exports of developing countries and undeveloped countries.

As we mentioned previously, the decision on which approach to apply to quantify the TBTs and trade impacts on TBTs, depends on accessibility of data. However, since WTO TBT agreement (2008) documents all TBT notifications, it is recommended to use the TBT agreement database, which is available through the website of WTO.

2.8 Ecolabelling: TBT or Welfare Standard

The growth of environmental activities during recent decades resulted in an increase of eco-labelling organizations engaged in environmental certification and ecolabelling programs (Delmas et al., 2013). These ecolabelling organizations (ELOs) are non-governmental institutions that offer ecolabelling programs and establish standards and rules of conduct in order to guide companies applying for ecolabelling. ELOs are not the only parties in conducting and operating ecolabelling standards. Civil society groups, industry associations, corporations, hybrid public-private organizations also have been created to control ecolabelling standards (Ven, 2015). Dauvergne and Lister (2010) suggested that ecolabels should be certified preferably by third parties (governmental or non-governmental organizations). In what follows, we discuss the history of ecolabelling, its current diversity, and resulting issues and consequences for regulations.

In 1978, the Federal Republic of Germany was the first country to introduce an ecolabelling program named “Blue Angel” (Melser and Robertson, 2005). The introduction of the program was motivated by the need to develop sustainable products in the country (Prieto-Sandoval et al., 2016; Reisch, 2001). After almost 35 years of success, Blue Angel covers more than 10,000 products in 80 product categories.6 Following the success of Blue Angel, the United Nations launched the first definition of sustainable programs and ecolabels, named “Our Common Future”, which contained a section to explain the importance of ecolabels to promote energy

savings and to limit the consumption of chemicals (WCED, 1987). In 1992, the European Union introduced its own ecolabelling scheme. Subsequently, some European and non-European countries presented their national and supra-regional environmental labels.7 For example, Nordic Swan is an official ecolabel in Nordic countries established in 1989 by the Nordic Council of Ministers.

In 1988, the Government of Canada created the Environmental Choice Program (ECP) to guide consumers in distinguishing products that are less harmful to the environment. The ECP became the second largest national ecolabelling scheme, and the oldest in North America, covering more than 300 categories of products and had been awarded to over 7,000 products and services. In mid-1990s, Environment Canada licensed TerraChoice to manage the ECP as a separate private entity, and the ECP was renamed to EcoLogo Program around the same time. In 2010, the program was acquired by Underwriters Laboratories (USA) that now owns and controls the program referred to by its new name, UL ECOLOGO, and represented by a newly designed label, which replaces the original EcoLogo label.

This wide range of ecolabelling programs created the need for standardization and unification of practices. In September 1996, the International Organization for Standardization (ISO) launched ISO 14001 in order to unify the diverse ecolabelling programs (Jiang and Bansal, 2003). According to ISO, over one million organizations in 175 countries have obtained and implemented ISO 14001 standards. ISO 14001 does not impose a specific technology but rather mandates firms to have their Environmental Management Systems (EMS) audited by the third party. In order to be certified by auditors, the production process must be clearly documented and evaluated by experts. To meet the requirements of ISO 14001, professional training and investment in documentation are required, resulting in additional expenses imposed on enterprises (Lim and Prakash, 2014). Evidence shows that, as a result, ISO 14001 is unaffordable for enterprises with lower revenues and profitability. Nevertheless, developed and developing countries have been motivated to implement the ISO certification in order to access the global market.

Jiang and Bansal (2003) studied the acceptance of EMS and ISO 14001 among producers in North America. They conducted interviews with the members of the Canadian Pulp and Paper Association who had either an EMS or ISO 14001 certification.11 They report that in 2003, the

cost of obtaining the EMS and ISO 14001 certificate was between $24,000 and $128,000, and the cost of their maintenance resulted in an additional $5,000-$10,000. They note that if a firm had already obtained the sophisticated EMS certification, the cost to be certified for ISO 14001 is much lower than for firms with no certification. The authors conclude that, despite the high costs, the competitive advantages of certification, such as external recognition, credibility, and procedural legitimacy, motivate most enterprises including those with financial problems to obtain ecolabelling certifications (Bansal, 2002; Jiang and Bansal, 2003). Factors like market demand, institutional pressure, and management control are also found to influence the demand for certification with ISO 14001.

Apart from ELOs, there exist other organizations that aim at promoting sustainable and environmentally friendly practices in Canada. In 2007, the Wine Council of Ontario (WCO) published documents in a series titled “Sustainable Winemaking Ontario: An Environmental Charter for the Wine Industry”, aiming at improving voluntary environmental initiatives.12 The WCO issued guidelines for new entrants into commercial grape-growing for the wine industry to support best practices of wine production regarding environment and sustainability. However, these guidelines create additional limitations for the new entrants, resulting in barriers to market entry. Berghoef and Dodds (2013) studied the interest of Ontario wine producers in ecolabelling by performing face-to-face interviews with the members of the Ontario wine industry. The authors collected information about producers’ interest, motivation and barriers to produce ecolabelled wine. The results show that industry members were concerned with the amount of resources required to obtain an ecolabel. In addition, some wine producers who reported willingness to participate in ecolabelling programs did not want to display the ecolabel on their products. In addition, some producers have claimed that their production is not harmful to the environment, and that they do not see the need to be certified by the third party.

The mission of ecolabelling programs is to issue series of regulations and standards to protect environmental resources. Ecolabelling regulations may be imposed on exporting countries by importing countries, and subsequently they affect trade in a way similar to technical barriers (Melser & Robertson, 2005). As results, ecolabelling is an important example of TBT and welfare standard.

Compared to developed countries, developing countries are found to be slower and less motivated to promote ecolabelling of their products (Melser and Robertson, 2005). For example, in their research on ecolabelling of forest products in developing countries, Drust et al. (2006) suggest that only 5% of certified products are produced in lower income countries (in particular, tropical countries), whereas the majority of certified products are produced in North American and European countries (91.8%).

EcoLabelling can have two different (apposite) impacts on trade. 1) Promotive: because of the environmental concerns and customer satisfaction, a product's demand is increased. Especially customers in other countries trust the product and trade is facilitated in importing countries. 2) Restrictive: the additional costs and complicated procedures and certificated, and the expense of exporting, impose high price on the final customer and destination market, that lead to decrease the level of product demand. In this case, ecoabeling regulation acts as technical trade barrier to trade (Maskus et al., 2000; Basu & Chau, 2001; Simi, 2009).

Despite the slow uptake and high cost of ecolabelling, studies show that producers in developing countries benefit from ecolabelling certifications. Charlson and Palmer (2016) conducted a study on Forest Stewardship Council (FSC) and MSC certification in developing countries. Their results indicated that ecolabelling benefited governance in developing countries, which compensated the expenses of ecolabelling certification.

Since technical barriers to trade (technical regulation and product standards) have attracted the concern of economists in global liberalization, ecolabelling has also become a question for modern researchers. There are some discussions among WTO members that ecolabelling should fall into Trade-Related Environmental Measures (TREMs) and that the regulations in the WTO TBT Agreement should be applied to them (WTO annual report, 2012). However, there are no standards or regulations that particularly focuses on ecolabelling in WTO TBT Agreement. Hence, whether or not the related justifications have to be part of TBT or Sanitary and Phytosanitary Measures (SPS), ecolabelling becomes an important concern for recent research (Basu & Chau, 2001). In other word, ecolabelling alternatively affects the competition on exports and appear as NTB while it emphasizes acting as non-discriminatory, transparent, and open standards in both domestic and international trade (Melser & Robertson, 2005).

Studies suggest that the variety of ecolabelling schemes and trust issues called for standardization and unification of practices resulting in the creation of the ISO 14001 standard. The ISO certification requires substantial investments of resources, which can be a problem for producers in less developed countries and, thus, create barriers to trade. To further harmonize international ecolabelling schemes, the Global Ecolabelling Network (GEN) sets up certification criteria and improves information exchange among its country members. Canada, as a member of the GEN, also included environmental assessments in its trade negotiations in order to fulfill objectives on environmental protection, with the most recent trade agreements containing a chapter on the environment.

2.8.1 Consumer Demand for Eco-Labeled Products

An increase in demand for eco-labelling would motivate firms to replace their regular production approaches with sustainable and environmentally friendly practices (Prieto-Sandoval et al., 2016). In order to steer consumers toward demanding more eco-labelled products, good understanding of demand mechanisms is necessary. In what follows, we review the current literature studying factors affecting consumers' demand for eco-labelled products.

There is strong evidence that consumers, in general, are willing to pay relatively higher prices for eco-labelled products (e.g., Bjørner et al., 2004; Cason and Gangadharan, 2002; Johnson et al., 2001). Lay (2012) summarizes premia for eco-labelled products found in empirical studies (see Table 1). Table 1 shows that Canadians were found to have fairly high willingness to pay (WTP) for eco-labelled products. Approximately 64% of Canadian consumers were willing to pay up to 10% more for products or services certified with EcoLogo. According to another source, 81% of Canadians were willing to pay a 10% premium for more environmentally friendly products, resulting in an increase of almost 9% in demand for "green" products between 1985 and 1990. The primary reason of eco-labelling success in Canada was the rise in environmental consciousness among Canadian consumers in the late 1980s and early 1990s (Hoving et al., 2004). A survey published in 1996 showed that by mid-1990s almost 20% of Canadians were aware of eco-labelling and had already bought at least one eco-labelled product (Forstbauer and Parker, 1996). Similarly, 82% of American consumers were found to be willing to pay more for eco-labelled products, but the average reported premium was lower (around 5%). A similar

premium of 5% was reported for Singapore. This price premium is significantly smaller compared to the European average (13%), and the premium in the UK (up to 25%).

Eco-labels are intended as a source of information for consumers regarding the practices used in the production of goods and services. Currently, empirical evidence on consumers' use, understanding, and perceptions of eco-labels is mixed. Main factors reported to be associated with higher demand and price premia are knowledge about ecological issues (Amyx et al., 1994; Vining and Ebreo, 1990), consumers' environmental values (McCarty and Shrum, 2001; Schwartz, 1994), consumers' environmental attitudes (McCarty and Shrum, 2001; Amyx et al., 1994), and consumers' purchasing behaviour (Laroche et al., 2001). Some studies find that people tend to feel happier when they buy eco-labelled products (Hamilton and Zilberman, 2006; Loureiro and Lotade, 2005). Other studies report that consumers expect eco-labelled product to have better quality compared to products not carrying an eco-label (Bougherara and Combris, 2009; Zanoli and Naspe, 2002). However, some researchers believe that eco-labelled products do not respond to customers' concerns about environment (Thøgerse, 2000; Erskine and Collins, 1997), and that some consumers interpret eco-labels as a signal of lower quality (Delmas and Lessem, 2015). Knowing these drivers of consumer demand are important because they can be changed by increasing the media coverage of environmental matters, introducing competition among eco-labelling products on the market, and integrating ecological values into products (Laroche et al., 2001).

Table 2.5: Willingness to pay for eco-labelled products

Country	Willingness to pay for green product
UK	33% of respondent willing to pay an average 13% premium for sustainably produced timber
UK	25-50% of respondents willing to pay up to 25% premium
Europe	37% of respondents would be prepared to pay 10% premium
Canada	64% of respondents willing to pay a 10% premium for a product bearing the EcoLogo
Singapore	5% premium for the Singapore Green Label

Souce: Lay, 2012

Some studies raise concerns regarding consumers' trust in eco-labels due to deceptive claims. For example, a study showed that two thirds of dishwashing liquids in Australia had been eco-labelled meaninglessly or inaccurately (Polonsky et al., 1998). Such deceptive practices were perceived as unethical because they aimed at manipulating the public and competing without expending any real effort to reduce the harmful impact on the environment. As a result, a survey showed that from 42% to 56% of consumers lost their trust in environmental claims (Church, 1994). This also dramatically discouraged enterprises who truthfully labelled their products. Therefore, to be successful, eco-labels must rely on verification by a third party, such as the Global Ecolabelling Network considered in more detail later in this review (Howard and Allen, 2010).

In order to crack down on deceptive claims in Canada, Consumer and Corporate Affairs Canada published the Competition Act and the Consumer Packaging and Labeling Act (Harrison, 2004). Prior to these acts, terms like "recycled", "recyclable", and "biodegradable" did not have a harmonized identification (Morris et al., 1995). In addition, the Office of Consumers Affairs introduced a list of common eco-labels and environmental schemes in Canada such as EcoLogo, Marine Stewardship Council Certification Logo, and Canada Organic Logo. The Office of Consumers Affairs forbids the use of any other environmental claims without their authorization, except claims of biodegradability or recyclability. The regulation is applied to all manufacturers, importers, distributors and anyone who promotes a product or service. The ECP of Canada has issued 50 guidelines and 39 certification criteria in order to help consumers identify products that do not harm the environment (Bartman, 2009). These approaches were intended to restore consumers' trust; however, issues with imported eco-labelled products remain to be unsolved.

Demand for eco-labelling varies not only across different countries but also across different eco-labels. Howard and Allen (2010) analyzed preferences for eco-labelled products in the United States. They conducted a survey where respondents were asked to rank five types of eco-labels that might feasibly be implemented by food producers. These five types were "humane", "local", "living wage", "small-scale" and "U.S.-grown". "Humane" refers to meat, dairy products, or eggs that come from animals that have not been treated cruelly. "Living wage" refers to producers who pay above-poverty wages to workers involved in producing food. "Local" refers to products grown within 50 miles of the point of purchase. "Small-scale" refers to small farms or businesses. Finally, "U.S.-grown" refers to products grown in the United States. Type "local" was the most

popular choice. Type “humane” was the second most popular choice, and the difference between the frequencies of choices of the two was very small. The results indicated that “local” was preferred by rural residents, and “humane” was preferred by organic consumers and high-income households. According to respondents, product labels were the first source of information about their food. In other words, eco-labels were seen as a signal that the product was produced and could be disposed harmlessly toward the environment. Not having the eco-label carried the opposite interpretation.

2.8.2 Trade Agreements for Ecolabelling

Developing countries need to apply environmental-friendly measures to prevent losing competition in worldwide trade (Shams, 1995; Melser & Robertson, 2005) . Suggested solutions are: “increasing the building of their exporting companies”, and “upgrading their facilities with purpose of compliance with elevated environmental standards”, and “participating in worldwide awareness of health and safety activities” (Melser & Robertson, 2005; Simi, 2009). Also mutual recognition of respective Eco-label among countries, will help the governments to compromise the importance of eco-labeling among different countries, the importance of ecolabelling, and change them from barrier to improving factor (Simi, 2009).

Another suggestion for disputes in the ecolabelling field is a standardized ecolabelling scheme for all countries. Countries according to their different production methods and domestic industries follow differently from each other that lead them to unequal standardization in eco-labeling. An equal framework for ecoLabelling encourages all countries to participate in environmental activities and convince their importer to trade with partners who apply the monolithic ecolabelling (Gesser, 1998). In addition, a Harmonization program with other eco-Labels, leads them to cooperate on associated environmental measures and regulations (Melser & Roberston, 2005).

The complicated impacts of ecolabelling standards brought them to trade bodies’ attention over the years. Harmonization, mutual recognition, and greater transparency in the operation of labeling scheme are solutions that suggested by OECD, UNCTAD, and WTO/ General Agreement on Tariffs and Trade (GATT). Moreover, there are many articles in the WTO that mentioned Eco-Labeling related standards and the related justification and notifications with the purpose of reducing the confliction in applying this type of standards. The “Code of Good

Practice for the Preparation", "Adoption and Application of Standards", and "Technical Barriers to Trade Agreement" are agreements that tried to solve the environmental measures dispute (Melser & Roberston, 2005; Simi, 2009).

The latest concern of the WTO is to motivate the poor nations to join the trade globalization committees (WTO annual Report, 2011). Technical assistance to enterprises in developing countries and poor nations, will improve the environmental safety requirements for their people, while encourage their government to import the standardized product or use the eco- label regulations to their exporting products.

Moreover, cooperation between exporting small or large firms with government and mutual understanding of the problems created by trade policy for exporting enterprises lead the government to have a real picture of obstacles made by ecolabelling standards. The lack of a labeling requirement prevents the exporter firms to participating in international trade. Thus, in these case ecolabelling act as technical barrier to trade (Fliess and Busquets, 2006).

2.8.3 International Organization for Standardization (ISO)

This wide range of ecolabelling programs created the need for standardization and unification of practices. In September 1996, the International Organization for Standardization (ISO) launched ISO 14001 in order to unify the diverse ecolabelling programs (Jiang and Bansal, 2003). According to ISO, over one million organizations in 175 countries have obtained and implemented ISO 14001 standards. ISO 14001 does not impose a specific technology but rather mandates firms to have their environmental management systems (EMS) audited by the third party. In order to be certified by auditors, the production process must be clearly documented and evaluated by experts. To meet the requirements of ISO 14001, professional training and investment in documentation are required, resulting in additional expenses imposed on enterprises (Lim and Prakash, 2014). Evidence shows that, as a result, ISO 14001 is unaffordable for enterprises with lower revenues and profitability. Nevertheless, developed and developing countries have been motivated to implement the ISO certification in order to access the global market.

Jiang and Bansal (2003) studied the acceptance of EMS and ISO 14001 among producers in North America. They conducted interviews with the members of the Canadian Pulp and Paper

Association who had either an EMS or ISO 14001 certification.11 They report that in 2003, the cost of obtaining the EMS and ISO 14001 certificate was between $24,000 and $128,000, and the cost of their maintenance resulted in an additional $5,000-$10,000. They note that if a firm had already obtained the sophisticated EMS certification, the cost to be certified for ISO 14001 is much lower than for firms with no certification. The authors conclude that, despite the high costs, the competitive advantages of certification, such as external recognition, credibility, and procedural legitimacy, motivate most enterprises including those with financial problems to obtain ecolabelling certifications (Bansal, 2002; Jiang and Bansal, 2003). Factors like market demand, institutional pressure, and management control are also found to influence the demand for certification with ISO 14001.

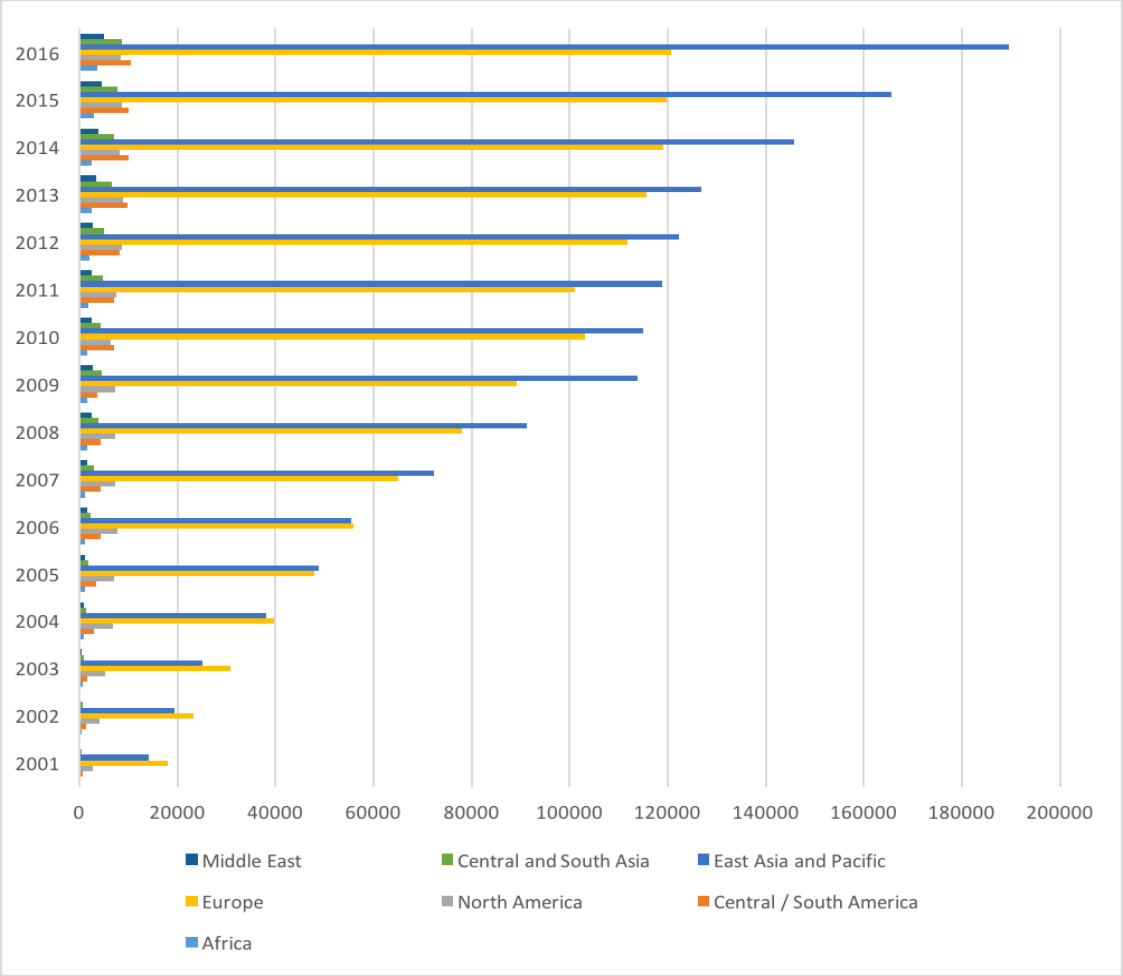

Figure 2.6: Number of ISO Certifications issued in period of (2001-2016). Source: ISO certification database (retrieved from https://www.iso.org on November 2017)

2.8.4 Global Ecolabelling Network (GEN)

The Global Ecolabelling Network (GEN) is a non-profit association of third-party, environmental performance recognition, certification and labelling organizations founded in 1994 in order to facilitate the harmonization of ecolabelling programs (Dauvergne and Lister, 2010). The association is by representatives of ecolabelling organizations who follow the Type 1 ecolabels as defined by ISO 14024. The mission of the GEN is to improve, develop, and promote ecolabelling of products and the credibility of ecolabelling programs worldwide. It fosters cooperation, information exchange and harmonization among its members. The GEN does not develop criteria or certify products, but supports members by developing environmental leadership standards in ecolabelling. Since the GEN is an association of labelling organizations, countries cannot become members of the GEN but are represented by the eco-labelling programs.

One of the activities of GEN members is setting criteria for products and services with lower environmental burdens to provide a framework to exchange their information and to cooperate among ecolabelling organizations. They define ecolabelling as the only program that is life- cycle based, voluntary, third-party, multi-sectoral, and selective, according to the definition of standards in ISO Type I, including 14024 (GEN Report, 2003). Moreover, their goal is to increase the supply and demand for environmental labelling products and services. However, despite all these efforts we suggest that the literature shows no evidence of the GEN's success in achieving its goals. We suggest that further research is needed to establish whether GEN membership eliminates uncertainty or improves the reputation of ecolabels for its member countries, especially those that are less developed.

In 2003, the GEN launched the Global Ecolabelling Network's Internationally Coordinated Eco-Labelling System (GENICES) process, a framework for evaluating and auditing the programs operated by GEN members to obtain mutual trust and recognition among all members. GENICES assures that the programs are in fact operating reputable Type I ecolabelling programs in accordance with ISO 14024. Applicants that successfully completed GENICES sign a multi-lateral mutual recognition agreement (MMRA).31 Members of the GEN conduct periodic reviews and update environmental criteria and categories through considering technological and marketplace development (RSMeans, 2011).

The ECP of Canada submitted the application for GENICES in March 2006. However, later in 2010, the ECP management was transferred to UL Environment who was already a member of the GEN, thus making Canada represented in the GEN as well. UL Environment is a global labelling company that reinforces credibility of sustainable product claims through their certification, validation and testing services. UL Environment assists companies in their evolution and execution and communication of their sustainability strategies and initiatives with advisory services. UL ECOLOGO certifies products that meet multi-attribute, life cycle-based sustainability standards. These standards set metrics for a wide variety of criteria for products in such categories as materials, energy, manufacturing and operations, health and environment, product performance and use, and product stewardship and innovation. Currently, there is no literature that analyzes the effect of Canada's participation in the GEN as well as the effect of the transfer of EcoLogo to UL Environment.

2.9 Conclusion

This chapter has reviewed the literature in order to demonstrate the current state of knowledge on TBTs. Although they are relatively new barriers to trade, TBTs have been defined and analyzed in several nuanced ways and aspects. This fragmentation can be misleading, and a systematic literature review can provide a useful classification in order to highlight the trade impacts of TBTs in different aspect and also propose boundaries to better define TBTs.

Through reviewing the literature, the findings are: 1) the majority of studies found negative trade impacts of TBTs on developing countries. 2) the majority of studies have found severe trade barriers caused by TBTs in agricultural sectors, 3) the firms effected by TBTs regarding to the sectors, products, and country. The heterogeneous firms have the option of diverting trade to other destinations that do not impose TBT measure (Fontagne et al., 2016), 4) if the WTO TBT agreement, harmonization, and MRAs, have been efficient approaches on eliminating the negative trade impacts of TBTs, 5) the majority of studies on trade impacts of TBTs used the gravity model as their methodology.

Based on our findings, the welfare aspects of TBTs have not been studied enough. As it mentioned several times in literature, quantification the welfare aspect of TBT is essential in order to find the proper management approach. Moreover, in literature there are examples on

quantification of trade impact of a specific standard or technical regulation. However, to our knowledge, there is no study that studies and compares the trade impact of TBTs regarding to their categories and objectives. For example, research can be done to compare the trade impacts of TBTs issued under category of "protection of human health or safety", with the trade impacts of TBTs in category of "prevention of deceptive practices and consumer protection". The result will provide a clear image of risk accompanied by TBTs in different categories. Therefore, section 5 of the dissertation is dedicated to explore the trade impacts of various categories of TBT.

CHAPTER 3 RESEARCH METHODOLOGY

This chapter explains the research methodology of dissertation including: problem statement and research questions, research method, research contributions and research framework. First, research questions, that are built upon research significance, existing problems of the research field, and literature gap. After positioning the research questions, the applied methods for data collection and data analysis are explained and justified. Next, the research contributions are situated followed by the research framework that indicate the phases upon which the dissertation is guided and completed.

3.1 Problem statement and research questions

NTBs arise from different measures taken by governments and authorities in the form of government laws, regulations, policies, conditions, restrictions or specific requirements, and private sector business practices, or prohibitions that protect the domestic industries from foreign competition (UNCTAD, 2013). However, the cost of non-tariff measures for developing and LDCs, bound to their weak domestic infrastructures, is higher than high-income countries. Expenses such as training specialists, establishing required systems, obtaining a license or a permit, etc. create drawbacks to remain competitive in international trade. To address the severity of such barriers on exporting firms in developing countries and LDCs, this dissertation defines its first research question as follow:

RQ1- How severely, if at all, do enterprises rate non-tariff barriers as obstacles to trade?

This research question includes three steps that are precisely explained in chapter 4. The question aims to first, compare the severity of the NTBs in various geographical locations, second, compare the severity of the NTBs for firms in various levels of exportation (level of engagement with global market), and third, compare the combination of both location and level of exportation.

The impact of TBTs significantly vary across countries with different levels of developments (Disdier et al., 2008). In order to enter the global market, exporters are obliged to imply technical regulations and standards. Also, the cost of regulation and standard compliance varies across sectors and products (Moenius, 2004; Maskus et al., 2013). In addition, according to WTO TBT

Agreement, TBTs have several categories. The categories of TBTs are defined by the premier objectives of the TBTs. There are some studies that analyze the trade impacts of TBTs for specific product or sectors, but to our knowledge there is no study that compares the trade impacts of TBTs differentiated by their categories. To address this gap, this dissertation aims to define its second research question as:

RQ2- Differentiated by categories, how do TBTs affect the international trade?

This research question includes four sub-questions that precisely are described in chapter 5. The question aims to compare the impacts of TBTs of different categories on exports in a case study model. For this matter, two countries are selected: United States of America, as a developed country and China, as an emerging country. For each country a database is created. Both databases contain data of TBTs notifications of the first three large categories. The TBT notifications are classified in agricultural and industrial sectors. The applied estimation technique is a series of mixed-effects models with temporal pseudo-replication also known as growth models, due to the time-series cross-section type of the data.

The implementation of non-harmonized TBTs adds up to producing cost (Fontagne et al., 2016). An example of non-harmonized regulation is ecolabelling regulations. The lack of existence of a harmonized ecolabel may create technical barriers (TBT) to exporters. In order to remain competitive in the global market, firms apply environmental friendly regulations that are certified by ecolabels programs and/or ecolabelling organizations. However, the variety of ecolabels called for standardization and unification of practices result in the creation of the ISO 14001 standard. To further harmonize international ecolabelling programs, the Global Ecolabelling Network (GEN) sets up certification criteria and improves information exchange among its ecolabelling organization members. However, to our knowledge, there is no evidence that explore the trade impacts of these two approaches (ISO and GEN) regarding eliminating the negative impacts of ecolabelling (as a TBT) on imports. Therefore, the third research question is as follow:

RQ3- How do un-harmonized ecolabelling programs impact international trade?

The environmental standards and ecolabelling regulations are mentioned in trade agreements such as WTO TBT Agreement, FTAs, and MRAs. To find an accurate answer to the third research questions we include the indicators of WTO, FTA, and MRAs in separate phases. Hence, this research question includes three phases that are precisely explained in chapter 4. The

applied model is a series of mixed-effects models with temporal pseudo-replication also known as growth model, due to the time-series cross-section type of our data.

3.2 Research Methods and Data

There are several quantification methods to measure the trade impacts of NTBs and TBTs. These methods are (but not limited to): "inventory measure", "price comparison", "business survey", "quantity impacts", "gravity models", "equilibrium models (partial and general)", and "cost-benefit analysis" that are expected to be more reliable to measure the trade impacts of NTBs and TBTs (Fugazza, 2013). For the purpose of data collection and analysis, this research applied logistic models for World Bank Enterprise Survey and the gravity models to accurately address the three research questions. The research methods presented in this section according to the research questions:

3.2.1 Logistic model: research question 1

To address the first research research question- How severely, if at all, do enterprises rate non-tariff barriers as obstacles to trade?-, we use the logistic model including categorical and binary logistic regression. The logistic model applied the data that is collected by World Bank Enterprise Survey. The World Bank Survey contains the firms responds on main obstacles that firms face in order to enter to or remain in the global market. Among the obstacles that are recognized by firms, we selected the obstacle related to NTBs to examine the severity of each NTBs as barriers to export. Firms are categorized according to the volume of their exports in brackets of 10-25%, 26-50%, 51-75%, and 76-100%. Also, these firms are sorted according to their location. These geographical categories are East Asia & Pacific, Europe & central Asia, Latin America & Caribbean, Middle East & North Africa, South Asia, and Sub-Saharan Africa.

The logistic model takes the severity of NTBs (according to the firms) as (categorical) dependent variables. We code the categorical dependent variable regarding the values from (0 to 4). Also, because the values of the dependent variables are ordered, the first model we design to analyze the data is an Ordinal Logistic Regression (OLR). In addition, for validity and robustness checks, we developed a binary dependent variable to test the accuracy of the OLR. Then, a Logistic regression was conducted in order to predict the probability that firms rank any of NTBs as severe barrier to export.

Data: research question 1

We used cross-sectional data from the World Bank Enterprise Survey.[8] In total, the World Bank Survey covered 130,000 firms in 135 developing and transition countries for the period 2006 to 2014. Business owners and top managers answer the Enterprise Survey. Sometimes the survey respondent invites company accountants and human resource managers to answer questions in the sales and labor sections of the survey. The Enterprise Survey is a firm-level survey of a representative sample of an economy's private sector. Typically, 1200-1800 interviews are conducted in larger economies, 360 interviews are conducted in medium-sized economies, and for smaller economies, and 150 interviews take place. (Appendix C)

The manufacturing and services sectors are the primary business sectors of interest. Formal (registered) companies with 5 or more employees are targeted for interview. Services firms include construction, retail, wholesale, hotels, restaurants, transport, storage, communications, and IT. Firms with 100% government or state ownership are not eligible to participate in this survey. The survey topics include firm characteristics, access to finance, annual sales, costs of inputs/labor, workforce composition, licensing, trade, competition, taxation, and business-government relations. Firm size levels are 5-19 (small), 20-99 (medium), and 100 and more employees (large-sized firms). Since in most economies, the majority of firms are small and medium-sized.

Firms are asked a variety of questions in addition to those relating to the major obstacles on business environment. These obstacles are included the ones related to access to finance, corruption, labor regulations, political instability, as well as nontariff obstacles which are tax rates, tax administration, customs and trade regulations, and business licensing and permits.

The survey responses refer both NTBs of the destinations and home countries. Depending on the NTB. For instance, NTB1 is the customs and trade regulation, imposed by home and destination country. Versus NTB2, tax rates that refers to the tax imposed by home country. The survey asked questions about the main NTBs those firms in home countries face in order to export. The research tackles the subject of exporting firms. According to the World Bank Enterprise Survey,

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[8] This is also known as the Business Environment and Enterprise Performance Survey (BEEPS). More information is available and the data accessible at http://www.enterprisesurveys.org

exporting firms are differentiated from other firms based on the share of their sales being exportations. The Enterprise Survey categorizes the firms as non-exporting and exporting. According to their description, an enterprise is exporting if at least 10 percent of its annual sales is derived from exports. Hence, the applied database, is limited to exporting firms that at least export 10% of their products. Therefore, the database includes 10,266 firms from 81countries covering the period of 2006-2004.

The World Enterprise Survey dataset is popular among researchers, in particular the studies on firms in (upper and lower) middle and low-income countries. For example, Carlin et al. (2001) used Enterprise Survey to analyze the factors that influence restructuring by firms and their subsequent performance as measured by growth in sales. Beck et al. (2004) used the data to analyze the access to credit across a range of countries including those in development transition. Later, Eifert et al (2008) estimated firm-level revenue and value-added function for six industries in 17 developing countries, demonstrating that firm performance is sensitive in estimation of value added. Further, Hudson et al. (2012) used this dataset to determine the impacts of the informal economy on businesses and employment relations in emerging countries in southeast Europe.

3.2.2 Gravity Model: research questions 2 & 3

The majority of scholars applied gravity model to analyze the trade impacts of TBTs. For example, Metha and Nambier (2005), Baller (2006), Disdier et al. (2005 and 2007), Yoann et al. (2014), Bao and Qiu (2010, 2012), Siyakiya (2017), and Wood et al. (2017). To address the second and third research questions, the gravity model was used. However, the gravity model includes Hecksher-Ohlin variables: market size (G), income similarity (S) (Warin et al., 2009).

Both the Heckscher-Ohlin variables take the following forms:

$$G_{ij,t} = log\left(GDP_{it} + GDP_{jt}\right)$$

and,

$$\mathrm{S}_{ij,t} = log\left[1 - \left(\frac{GDP_{it}}{GDP_{it}+GDP_{jt}}\right)^2 - \left(\frac{GDP_{jt}}{GDP_{jt}+GDP_{it}}\right)^2\right]$$

The databases used to answer question 2- differentiated by categories, how do TBTs affect the international trade? - and research question 3- how do un-harmonized ecolabelling program impact international trade? - , are cross-section time-series databases. Each cross-section has its own individual features, which may (or may not) influence the predictor variables (Eisenhart, 1947). A Hausman test is performed to see whether time-invariant characteristics are unique to the individuals (Stock and Watson, 2003; Bartels, 2008). And regarding the data, both fixed and random effects models are tested. As a result, the best estimation technique is a set of multilevel linear regressions. As Hox and Kreft (1994) explained: "multilevel models assume a hierarchically structured population, with random sampling of groups both groups and individuals within groups". These models are linear models with (1) fixed effects to take into consideration parameters corresponding to an entire population and (2) random effects, parameters corresponding to individual units drawn at random from a population. Since multilevel models are selected, some underlying assumptions must be checked.[9]

The estimation technique is thus a set of multilevel models, with some temporal pseudo-replication due to the time-series cross-section (TSCS) type of the data. The Generalized Least Squares (GLS) technique (Parks, 1967) is the method that is often used with TSCS data. However, GLS technique for TSCS may produce inaccurate standard errors and violates the Gauss-Markov assumption (Beck and Katz, 1995). Indeed, in our data, each country may have its own error variance (heteroscedasticity). To deal with heteroscedasticity, dummy variables are created to represent each country. Thus, each country has its own intercept. Hsaio (1986) shows that fixed effects are suitable if one wants to make inferences to the units observed.

For validity, a set of models is tested. First, to deal with heterogeneity, the random coefficients model (RCM) is used (Beck and Katz, 2006; Swamy, 1970). Regarding our data, the RCM as the "Random Intercepts" (Model 2) is selected to add some more validity to the analysis.[10] Second,

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[9] There are five fundamental assumptions for multilevel models: (1) within-group errors are independent with mean zero and variance σ^2, (2) within-group errors are independent of random effects, (3) random effects are normally distributed with mean zero and covariance matric ψ, (4) random effects are independent in different cross-sections, and (5) the covariance matrix does not depend on the cross-section.

[10] The random part of the model is specified as the name of the country, which means only the intercepts vary across countries.

the current random model is augmented with time fixed effects. The third model is calibrated with time as a predictor of trade inflows and random intercepts across countries (see column "Time RI" - Model 3). Fourth, a next model is calibrated with the effect of time being different across countries (varying slopes across countries) (see the "Time RS" column - Model 4). The fifth model introduces a term that models the covariance structures and errors (see the "Auto Regressive" column - Model 5). The empirical analysis is based on a variant of the gravity model, commonly used to analyze bilateral trade flows. Since the dataset includes missing observations, the actual dataset is unbalanced.

Data: research question 2

To address the second research question - differentiated by categories, how do TBTs affect international trade? -, we created two databases for the countries of the case studies: China and United States of America. The databases contain the number of TBT notifications in agricultural and industrial sectors in three more important categories of TBTs: protection of human and health or safety's, protection of the environment, and quality requirements.

The database created based on counting regulation approach, through counting TBTs notification that are issued in WTO TBT Agreement. Each regulation in TBT agreement, include the primary objective (category), and sector of the product that the notification applied. The TBT notifications are classified upon the product sectors they cover. The databases cover 96 classifications on agricultural and industrial products at the HS2-digit level. The products under HS code of 01 to 24 belong to agricultural sectors and the product under HS codes of 24 to 95 belongs to industrial sectors. Therefore, the database includes number of TBTs notifications, in 6 categories (primary objectives regarding TBT Agreement), and in two sectors of agricultural and industrial. That leads to creation of unique database on TBT notifications that give the opportunity for further studies in this matter.

The dependent variable is exports from China and the US, to the 27 country members of the EU covering the period of 2001-2015. The dependent variable is the logarithm of the exports share of exporting country (country i: China and the US) of GDP of the importing country (country j: the EU country members). The independent variables include, the length of membership of the EU country members, market size, market similarity, and distance. The exports and TBT notifications are grouped in two sectors: agricultural and industrial. One of the objectives of this

study is also to compare the impact of the TBTs in agricultural sectors with the impact of TBTs in industrial sectors. Therefore, the exports from China and the US is grouped in two sectors: agricultural and industrial as well as the TBTs notifications. The classification is made upon the HS-2Level classification.

Data: research question 3

To address the third research question- how do un-harmonized ecolabelling program impact international trade?- we designed a cross-section time-series database. The dependent variable is the exports to Canada on period of 2003-2013. The data is collected from the Statistics Canada database in Canadian dollars. The data cover export values of all categories based on the 6-digit commodity level using the harmonized system (HS).

The Independent variables include the gravity variables (distance, common border and common language), the Heckscher-Ohlin variables (market size and market similarity), variables related to harmonization program on ecolabelling (ISO 14001 and GEN) and variables regarding the trade agreements concerning ecolabelling regulations (WTO, FTA, and MRA). The model chose the dependent variable is exports to Canada in period of 2003-2013. Similarly, to answer question 3 a series of the estimation techniques is applied.

The data for geographic distance, common border and common language are obtained from CEPII.[11] The data regarding the FTA and MRA are collected from Global Affairs Canada and Industry Canada.[12] Information about the membership for current GEN members are available on the GEN website.[13] Also, the data related to WTO are collected from the WTO database available online.[14]

The main difference between the two gravity models of article 2 and article 3, is in adding TBTs notifications as independent variable. To measure TBTs there are four main approaches: counting TBT notifications, overage ratio, frequency index, and price-wedge approach. Regarding the

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[11] Research and expertise on the world economy. For further information, please refer to: http://www.cepii.fr

[12] For further information, please refer to: http://www.international.gc.ca

[13] For further information, please refer to: https://globalecolabelling.net

[14] For further information, please refer to: http://stat.wto.org

accessible data, we applied the counting TBT notifications approaches. As we compared the EU imports from China and the US in both sectors of agricultural and industrial, therefore we elaborate two databases on TBTs notification. The database on agricultural sectors includes TBT notifications based on TBT agreements in agricultural sector (01HS – 24HS), and the database on industrial sectors includes TBT notifications in industrial sectors (25HS-96HS).

3.3 Research contributions

This dissertation contributes to the growing literature of non-tariff barriers and technical barriers to trade studies through presenting the three original articles as follows:

Farnia, F., de Marcellis-Warin, N., Warin, T., (2018). Easing the Burden of Non-Tariff Barriers: A Regional and Firm-Level Data Analysis. *International Journal of Economics and Business Researches*. (In press)

Farnia, F., de Marcellis-Warin, N., Warin, T., (2018), Technical Barriers to Trade: A European Case Study. *Journal of Economic Integration. (submitted)*

Farnia, F., de Marcellis-Warin, N., Warin, T., (2018). Technical Barriers to Trade: A Canadian Perspective on Ecolabelling. *Global Economy Journal*. Volume 18, Issue 1, 20170090, ISSN (Online) 1553-5304, DOI: https://doi.org/10.1515/gej-2017-0090.

3.4 Research framework

The framework is built upon the review of literature, problem statement and research questions, and research methodology that result in three articles, which contribute to the studies of non-tariff and technical barriers to trade in communication field of research. This research investigated the negative impacts of non-tariff barriers in firm level and trade impacts of technical barriers to trades. In what follows, each of the three articles is briefly explained.

3.4.1 Article 1: Non-Tariff Barriers in a South-North Model

This article aims at providing a firm-level analysis of non-tariff barriers' (NTBs) categories based on the importance of exports for domestic firm across diverse regions in the world. It exploits cross-sectional data from the World Bank enterprises surveys of 10,266 firms across 81 countries covering the period from 2006 to 2014. The study focuses on four NTBs: customs and trade

regulations, tax rate, tax administration, and business licensing and permits. Moreover, the firms are compared based on the level of exportations. The levels of exports are 10-25%, 26-50%, 51-75%, and 76-100%. This study is presented in chapter 4.

3.4.2 Article 2: Technical Barriers to Trade: A European Case Study

In this paper, we analyze how TBTs with different objectives influence the export to the members of the European Union. We built a database of all TBTs' notifications issued during 2008 to 2015, and categorized them based on their primary objectives. Also we separated the TBTs regarding the sectors they belong: agricultural and industrial. This data exported from WTO TBT agreement, which came to force in 2008. We selected the first three largest categories of TBTs, and studies their impacts on two countries: United States and China. This case study is presented in chapter 5.

3.4.3 Article 3: Technical Barriers to Trade: A Canadian Perspective on Ecolabelling

Ecolabelling is a market-based instrument and an important element of international environmental policies. In our day and age, there is a wide range of ecolabels, which may complicate the decision-making process when looking for the best outcome for consumers and producers. The International Organization for Standardization (ISO) and the Global EcoLabelling Network (GEN) suggest a framework, which includes the requirements for Environmental Management System (EMSs). The GEN harmonizes international ecolabelling schemes and improves exchanges of information among its country members. This article addresses how unaligned and aligned regulations impact international trade. Consequently, a database including ISO 14001 certifications of all countries, which contains the exports from 153 countries to Canada from 2001 to 2015 as a dependent variable, is created. The remaining variables will serve as independent variables, including gravity variables such as market size, market similarity, distance, and some other core variable such as GEN membership of the exporting country, WTO membership, binding in FTA, and binding in MRA with Canada. This study is presented in chapter 6. Table 3-1 summarizes the three original scientific articles, including their research questions and objectives.

Table 3.1: Overview on dissertation structure

	Article 1	Article2	Article3
Title	Easing the Burden of Non-Tariff Barriers: A Regional and Firm-Level Data Analysis	Technical Barriers to Trade: A European Case Study	Technical barriers to trade: A Canadian perspective on ecolabelling
Research Question	How severely, if at all, do enterprises rate non-tariff barriers as obstacles to trade?	Differentiated by categories, how do TBTs affect the international trade?	How do un-harmonized ecolabelling programs impact international trade?
Keywords	Non-tariff barriers to trade; exporting firms; upper-middle income countries; lower-middle income countries; enterprises survey; regional data analysis; firm-level data analysis	Technical barriers to trade; European Union; TBTs categories; TBTs objectives; China; the USA; international trade; exports	Technical barriers to trade; Ecolabelling; Export; Canada
Objectives of	Study the probability of rating NTBs as severe barrier in firms' perspective, and comparing NTBs across regions and in various levels of exportation	Identify the burden trade impact of TBTs in international level, regarding the TBTs categories and objectives.	Identifying the relative impacts of harmonized ecolabelling program (ISO and GEN) on exports to Canada. Studying the relation between the trade organizations and agreements concerning ecolabels (WTO, FTA, MRA) and exports to Canada.
Publication statue	Accepted by International Journal of Economics and Business Research (In press)	Submitted to Journal of Economic Integration	Published in Global Economy Journal

CHAPTER 4 ARTICLE 1: NON-TARIFF BARRIERS IN A SOUTH-NORTH MODEL

Abstract[15]

This article aims at providing a firm-level analysis of Non-Tariff Barriers' (NTBs) categories based on the importance of exports for domestic firms across diverse regions in the world. It exploits cross-sectional data from the World Bank Enterprise Surveys of 10,266 firms across 81 countries covering the period from 2006 to 2014. The study focuses on four NTBs: customs and trade regulations, tax rate, tax administration, and business licensing and permits. Firms were analysed according to levels of exports and locations. The results show that tax rate and business licensing and permits are more likely to be rated as a severe barrier. The tax administration and customs and trade regulations are more probable to be ranked as minor or no obstacle to trade. The business licensing and permits and tax rate are more likely to be ranked as a severe barrier for the firms within the 51-75% level of exports. In addition, the majority of the firms with 26-50% of exports are more likely to rank tax administration and customs and trade regulation as severe barriers.

Keywords: Non-tariff barriers to trade; exporting firms; upper-middle income countries; lower-middle income countries; enterprises survey; regional data analysis; firm-level data analysis.

This article has been accepted to be published in International Journal of Economics and Business Research, with title "Easing the Burden of Non-Tariff Barriers: A Regional and Firm-Level Data Analysis"

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[15] Farnia, F., de Marcellis-Warin, N., Warin, T., (2018). Easing the Burden of Non-Tariff Barriers : A Regional and Firm-Level Data Analysis. *International Journal of Economics and Business Research,* FORTHCOMING.

4.1 Introduction

This article is about understanding what really constitutes an impediment to international trade. We perform this analysis at the individual level, directly from what individual exporters have to say about non-tariff barriers (NTBs) based on three dimensions:

1 their level of exports

2 their region of origin

3 the NTB's category.

In the past 20 years, tariffs have dramatically declined, at once for low-income countries as well as high-income countries. However, NTBs have gradually replaced the traditional barriers to trade. NTBs are barriers that are created by different measures taken by governments and authorities in the form of government laws, regulations, policies, conditions, restrictions or specific requirements, and private sector business practices, or by prohibitions that protect the domestic industries from foreign competition (UNCTAD, 2002). Moreover, NTBs also include unjustified and/or improper application of non-tariff measures (NTMs). The 'NTM' term includes export restrictions as well as export subsidies – or measures with similar effects – not just import restraints. Hillman (1991) defines NTBs as NTMs directly impeding the importation of goods into a country. NTM is the most widely used term in GATT and UNCTAD, when scholars generally prefer the terms 'barriers' or 'distortions'. This article uses the NTB terminology. Recently, the traditional NTBs have been replaced by new forms, such as technical barriers to trade (TBT) and sanitary and phytosanitary (SPS) measures (Imbruno, 2016).

Our dataset is constructed based on the World Bank Enterprise Survey. We analyse the probability that a firm rates the NTBs as a very severe hindrance, and we compare the results across different regions and with different levels of exports. The World Bank Enterprise Surveys ask firms to rate NTBs from not difficult to very severe, based on their experience in exports. In total 131,000 firms in 139 countries have been surveyed (by February 2018), and the countries are grouped into low, lower middle, upper middle, and high-income economies. However, the selected sample for this article contains only the exporting firms (defined as countries with an export percentage of 10% or more). Eventually, we selected a large sample of 10,266 firms.

NTBs do not seem to be a big impediment on trade. The NTBs are relatively unimportant for most of the trade between high-income countries (Hoekman at al., 2002). However, the majority of NTBs are applied to the sectors that are great sources of income for developing countries and least developed countries (LDCs)- fisheries, forestry products, leather or textiles (UNCTAD, 2002). In addition, it appears that some trade procedures are longer for low-income countries. For instance, it takes on average more time to ship a container from Africa to the rest of the world (31 days) or from the outside world to Africa (38 days) than any other region in the world (Seck, 2017).[16]

Previous research shows the wide variation of ways to deal with NTBs across countries at different levels of development (Gandal and Shy, 1998). The cost of compliance re-tooling, product re-designing, testing, and certifications can be large enough to discourage many small and medium firms from entering the global market (Jouanjean et al., 2011). Therefore, the cost of NTBs is expected to be higher for firms in developing countries and LDCs, bound to the weak domestic infrastructures, in comparison with high-income countries. Expenses such as training specialists, establishing required systems, obtaining a license or permit, etc., create drawbacks to remain competitive in international trade for lower and middle-income countries.

The goal of this article is to shed some new light about how firms (from upper middle, lower middle and low income countries in particular) view some NTBs as impediments to trade, while considering the different levels of exportations and locations.

The majority of related previous studies focus on the impacts of the NTBs on international trade through a country or sectorial perspective. On the contrary, this article targets the firms' perspective on dealing with NTBs. The motivation of this article is to address the severity of each NTB from the enterprises' perspective. As the studied population contains 10,266 enterprises, we grouped the enterprises based on their location and level of exports. In addition, the article provides a comparison between countries with high volumes of exports and the one with lower volumes of exports, in ranking various categories of NTBs. It is important to note that besides

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[16] US$2,108 to ship a container outside the average African country, and US$2,793 to send a container in the opposite direction (respectively 2.5 and 3.2 times as much as it costs to trade in East Asia and the Pacific)

restrictive impacts on trade, NTBs have also welfare-improving impacts on consumers. Indeed, NTBs are often created to better inform consumers or protect them from buying hazardous products or services, and therefore they correct imperfect or deceptive information (Disdier et al., 2008; Movchan and Shportyuk, 2008). This very dual nature creates some confusion to identify NTBs as "legitimate" barriers or not. In this article, the regulations and measures creating impediments to trade (from the perspective of the firms) are considered as NTBs. When an exporting firm rates an NTB as a very severe obstacle, it is understood as the NTB hinders the firm's exports dramatically, regardless of the 'legitimate' nature of the regulation. The results presented in this article are very practical and may be used for trade negotiators, or export agencies in order to facilitate the access to global markets.

4.2 Literature Review

The existing literature on NTBs is centered on three topics:

1 the definition

2 the measurement

3 the impact evaluation (Movchan and Shportyuk, 2008).

In addition to the academic literature, international trade organisations such as WTO and UNCTAD contribute to clarify and formulate NTBs. The literature review is organised as follows: NTBs in a global perspective and NTBs in firms' perspective.

The first step in identifying the impacts of NTBs in both trade and welfare orientation requires a classification of NTBs (Carrère and De Melo, 2011).[17] This study follows strictly the WTO classification. The initial dataset is collected from the World Bank Enterprise Surveys. The survey focused on the general barriers to trade and the level of severity that each barrier causes to the firm. Based on the WTO classification, four of these barriers are qualified as NTBs:

1 *customs and trade regulations* fall in customs, TBTs, and SPS,

[17] The more information is available in Trade Analysis Information System (TRAINS) by UNCTAD organization. TRAINS is a comprehensive computerized information system at the HS-based tariff line level (HS 6-digit)

2 *tax rates* falls in the category of charges on imports,

3 *tax administration* falls in administrative procedures, and

4 *business licenses and permits* that depending to the type of the permits falls in TBTs or government participation in trade.[18]

4.2.1 NTBs in global perspective

Welfare-improving and trade-restrictive aspects of NTBs create complexity in identifying their impacts on global trade. Figuring out the nature of these impacts requires some specific information such as for instance a detailed knowledge about the NTBs, the process to imply the NTBs, and their methods of implementation. In addition, this study aims to evaluate the NTBs from the exporting firms' perspective, thus requiring to consider the whole set of NTBs' categories (Roberts et al., 1999).

Roberts et al. (1999) suggest a framework to analyse measures such as NTBs' impacts on trade in a global setup. This model is composed of "regulatory protection", "supply shift", "demand shift" elements. Although the model focuses on agricultural sector, it can explain the NTBs' impacts on other sectors. The model introduces a regulatory protection with no externalities both from an importer's and exporter's perspective. The impacts of NTBs can be presented in two perspectives: Importer country and Exporter country.

In the international trade context, NTBs are applied by importers to all exporters (universal) or apply to one exporter (specific). In order to explain the scope of these measures (in this article NTBs) from an exporters' and importers' view, Roberts et al. include the importer's perspective as well as the compliance expenses. 4.1 presents the scope of measures for both importers' and exporters' approaches in two cases, universal and specific.

[18] Literature defined other classification for the NTBs. Appendix B shows three of these classifications including the WTO classification.

Table 4.1: Scope of Measures, Exporter and Importer Perspective

	Regulations imposed on one exporter (specific)	Regulations imposed on all exporters (universal)
Regulations imposed on one importer (specific)	Avoid costs of compliance by trade with another market	Importers have to pay the cost of compliance
Regulations imposed on all importers (universal)	Exporters have to pay for the cost of compliance in order not to lose the market	Both importers and exporters have to pay the cost of compliance

The present study focuses specifically on the box "Exporters have to pay for the cost of compliance in order not to lose the market" approach. This scope of measures explains that in order to enter into the global market, all exporting firms should comply with the new regulations. For this study, the data were collected for exporting firms facing regulations that are universally applied (approach: all importer-universal). Based on this scope of measures, the assumption is that the firms with higher level of exports have to pay higher costs versus the firms in lower levels of exports (higher cost of compliance).

4.2.2 NTBs in firms' perspective

There are meaningful differences between firms choosing to target global markets and firms choosing to remain on the domestic market (Aw and Hwang, 1995; Aw et al., 1997; Clerides et al., 1998; Bernard and Jensen, 1999; Alvarez and Lopez, 2005; Wagner, 2007). Exporting firms are likely to be larger, to be foreign-owned, to pay higher wages, to be more capital intensive, and tend to be more productive than non-exporting firms. Several factors affect the decision of a firm to export or not, applying the WTO classification highlights, which are considered the NTBs.

The literature review highlights that the level of exports of a firm depends also on the managers' perceptions about the obstacles or barriers to export (Arteaga-Ortiz and Fernandez-Ortiz, 2010). NTBs often require adapting the products and services to the different markets and this may be perceived as a trade barrier (Keng and Jiuan, 1998; Kedia and Chhokar, 1986).

Clarke (2005) studies the factors that affect the exports performance of enterprises in eight African countries: Ethiopia, Mali, Mozambique, Senegal, Tanzania, and Uganda (low income),

Kenya and Zambia (lower middle income). He used surveys of manufacturing enterprises conducted by the Regional Program on Enterprise Development (RPED) unit of the World Bank (Investment Climate Surveys), in collaboration with local partners within the countries during the 2002-2003 period. Restrictive trade and customs regulations have a significant negative effect on exports. The author explains that customs administrations are slow and prone to corruption in many African countries. Similarly, Yoshino (2008) concludes that factors such as customs delays and efficiency do matter for textile exports from African countries to the global markets.

Vinokurov et al. (2015) interviewed the firms' managers from Belarus (upper-middle income), Kazakhstan (upper-middle income), and Russia (upper-middle income) of companies exporting goods and services to Eurasian Customs Union (EACU) and the Eurasian Economic Space or Single Economic Space (SES) in order to study the NTBs' costs. As the results show, the most restrictive impact on trade is associated with NTBs to exports from Kazakhstan. Kazakh enterprises estimate that, on average, the barriers associated with the entry into Belarus and Russian markets are respectively 10% and 15% of the costs of the organization. Belarusian firms evaluate these two types of barriers up to 10% for Russia and Kazakhstan. The lowest NTB costs are typically for Belarusian exporting enterprises. On average, the Belarusian respondents felt that the NTBs (permits, licenses, procedures associated with the activity, and others) have a significant restrictive impact on the rendering of financial services in Kazakhstan, and a moderately restrictive impact in Russia.

For instance, to remain competitive, the firms in their home countries need to complete additional procedures such as licensing and permits (Clarke, 2008). Despite these administrative costs, there is a relatively high demand for them. Obviously, firms are aware of the crucial role these permits have on their potential success in global markets. Other indicators such as the number of days to obtain an operating license and number of days to obtain a construction permit are important for an enterprise to decide to export globally or not.

Another factor is customs and trade regulations, which mainly affect the volume of exportations. In most of the lower-income countries, it takes a relatively longer time for exporting enterprises to clear customs procedures. Moreover, the bureaucracy and paperwork in some countries create a burden on exports (Milner et al., 2000).

The last significant factor that influences exports is government regulations and policies. The evidence from the literature suggests that the more governments impose regulations on firms, the more firms find it costly to export. Hence, firms favour the domestic market (Clarke, 2005).

4.3 Methodology and Data

4.3.1 Data

We use cross-sectional data from the World Bank Enterprise Survey.[19] The survey in total covered 130,000 firms in 135 countries for the period 2006 to 2014. Business owners and top managers are the focus of the Enterprise Survey.[20] It is a firm-level survey of a representative sample of a country's private sector. Typically, 1200-1800 interviews are conducted in larger economies, 360 interviews are conducted in medium-sized economies, and for smaller economies around 150 interviews took place. (Appendix C)

The manufacturing and services sectors are the primary business sectors of interest. Formal (registered) companies with 5 or more employees are targeted for the interviews. Services firms include construction, retail, wholesale, hotels, restaurants, transport, storage, communications, and Information Technology (IT). Firms with 100% government/state ownership are excluded. The survey topics include firm characteristics, access to finance, annual sales, and costs of inputs/labor, workforce composition, licensing, trade, competition, taxation, and business-government relations. Firm size levels are categorized as 5-19 (small), 20-99 (medium), and 100 and more employees (large-sized firms). Appendix C presents a description of size of surveyed firms in countries and regions.

Firms were asked a variety of questions in addition to those related to the major obstacles about business environments. These obstacles are related to access to finance, corruption, labor regulations, political instability, as well as non-tariff obstacles, which are *tax rates*, *tax administration*, *customs and trade regulations*, and *business licensing and permits*.

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19 This is also known as the Business Environment and Enterprise Performance Survey (BEEPS). More information is available and the data accessible at http://www.enterprisesurveys.org

20 Sometimes the survey respondent invite company accountants and human resource managers to answer questions in the sales and labor sections of the survey

The survey responses refer to both NTBs of the destinations and home countries. For instance, NTB1 is the 'customs and trade regulation', imposed by home and destination countries. NTB2 – 'tax rates' - refers to the tax imposed by home countries. The survey asked questions about the main NTBs which firms in home countries have to face in order to export.

The World Enterprise Survey dataset is popular among researchers, in particular the research on firms in upper-middle, lower-middle, and low-income countries. For example, Carlin et al. (2001) used the Enterprise Survey to analyse the factors that influence restructuring by firms and their subsequent performance as measured by growth in sales. Beck et al. (2004) used the data to analyse the access to credit across a range of countries including those in development transition. Later, Eifert et al. (2008) estimate firm-level revenue and value-added functions for six industries in 17 developing countries, demonstrating that firm performance is sensitive to the value added estimation. Furthermore, Hudson et al. (2012) used this dataset to determine the impacts of the informal economy on businesses and employment relations in emerging countries in southeast Europe.

This article tackles the subject of exporting firms. According to the World Bank Enterprise Survey, exporting firms are differentiated from other firms based on the share of their sales being exportations. The Enterprise Survey categorizes the firms as non-exporting and exporting. According to their description, an enterprise is exporting if at least 10 percent of its annual sales is derived from exports.

Our sample is thus constituted of 10,266 firms. The Enterprise Survey dataset shows that almost 17.5% firms are considered exporting firms for the selected period. The share of exporting firms varies widely across countries ranging from 75.8% in Thailand to 0.8% in Iraq. In average, 22.03% of Latin America firms and 18.09% of Sub-Saharan Africa firms are labeled as exporting firms.

The survey asked questions about the main NTBs those firms in home countries face in order to export. These NTBs are: customs and trade regulation, tax rates, tax administration, and business licensing and permits. The answer scale ranges from 0 (= no obstacle) to 4 (= very severe). Figure 4.1 illustrates how answers vary across regions. The data show that firms in *sub-Saharan* suffers the most from NTBs. However, the rating of NTBs is different among regions. For example, firms in the *Middle East & North Africa* rank customs and trade regulations as NTBs,

higher than firms in *Latin America & Caribbean*. This is different for tax rate. Firms in the *Middle East & North Africa* rank tax rate as NTBs, less than firms in *Latin America* and Caribbean. Furthermore, according to the survey, firms in *East Asia & Pacific* are less impacted by these four NTBs.

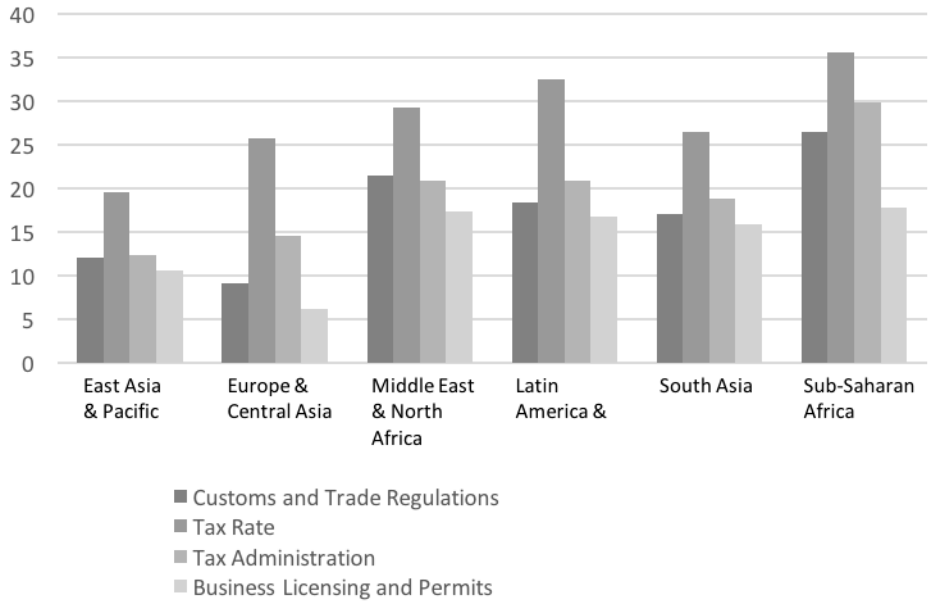

Figure 4.1: Share of each NTB identified as "very severe" barrier by firms (in percentage).
Source: World Bank Enterprise Survey (2006-2014)

Moreover, Figure 4.1 depicts how the share of the rate to NTBs differs between regions. For instance, in East Asia & Pacific, firms mostly chose tax administration as an obstacle versus in *Latin American & Caribbean* tax rate was more chosen than other NTBs. Also, business licensing and permits tend to be less chosen in *Europe & Central Asia* as well as in *East Asia & Pacific.* Meanwhile, customs and trade regulation has been rated more frequently by firms in *Sub-Saharan Africa* in comparison to other regions.

Additionally, data conveying how firms rated the impacts of each NTB on the amount of their exports was measured using a 5-level scale weighted as follows:[21]

21 A few of the responses to survey questionnaire had been coded already.

$$NTB_k = \begin{cases} 0 & if\ no\ obstacle \\ 1 & if\ minor\ obstacle \\ 2 & if\ moderate\ obstacle \\ 3 & if\ major\ obstacle \\ 4 & if\ very\ severe\ obstacle \end{cases} \quad (1)$$

Finally, the selected NTBs are as follow:

NTB1: customs and trade regulations

NTB2: tax rate

NTB3: tax administration

NTB4: business licensing and permits

Table 4.2 presents the Pearson correlation coefficient between the 4 NTBs. Regarding the general guideline provided by Cohen (1988), the correlation between the NTBs is small ($0.1<|r|<0.3$). The only significant coefficient is between NTB2 and NTB3. Therefore, we expect to reach almost similar results for NTB2 and NTB3.

Table 4.2: Pearson correlation coefficients

	NTB1	NTB2	NTB3	NTB4
NTB1	1.000			
NTB2	0.1075	1.000		
NTB3	0.1072	0.4599	1.000	
NTB4	0.1052	0.2404	0.2934	1.000

Model

We changed the values of NTBs regarding formula 1 (values from 0 to 4). Also, because the values of the dependent variables are ordered, we will test the validity of Ordinal Logistic Regression (OLR) estimation. Indeed, to decide which method to use, we will have to verify some assumptions. Following is the logit model for the categorical dependent variable:

$$p_{ij} = \Pr(y_j = i) = \Pr(\kappa_{i-1} < x_j\beta + u \leq \kappa_i) \quad = \frac{1}{1+e^{(-k_i+\sum x_j\beta_j)}} - \frac{1}{1+e^{(-k_{i-1}+\sum x_j\beta_j)}} \quad (2)$$

This model estimates the probability of a given observation with the ordered logit regression. κ_i is defined as the number of categories for the dependent variable. The y_j is the dependent variable, which in this article takes the values of NTB1, NTB2, NTB3, and NTB4. Variables x_j are the independent variables, which in this article are: region, level of exports, and the interaction variable of region and level of exports (variable region:expoProb).

In addition, for validity and robustness checks, we developed a binary dependent variable to test the accuracy of the OLR. The assumption is that if a firm ranked the NTB_k as very severe (ranked as 4), it is an effective barrier to trade. Therefore, we created a binary variable for each NTB_k, taking the value of 1 if the NTB_k is rated as 4 and 0 if the $NTB_k$is rated as 0, 1, 2, or 3. Then, a Logistic regression was conducted in order to predict the probability for a firm to qualify any of the NTBs as an effective barrier by the firms. Therefore, the following model is applied:

$$\Pr(Y = 1|x_1, \dots, x_k) = \frac{1}{1+e^{-(\beta_0+\beta_1 x_1+\cdots+\beta_k x_k)}} \quad (3)$$

Firms are categorized according to the volume of their exports in brackets of 10-25%, 26-50%, 51-75%, and 76-100%. Also, these firms are categorized according to their location. These geographical categories are *East Asia & Pacific*, *Europe & central Asia*, *Latin America & Caribbean*, *Middle East & North Africa*, *South Asia*, and *Sub-Saharan Africa*.

This categorization allows us to capture the potential threshold effects. As this article looks into the probability of ranking NTBs as severe barriers by firms in various regions and with various exports, it is easier to categories firms with 4 scales (10-25%, 26-50%, 51-75%, and 76-100%).

4.4 Results

The available data in the regions Middle East & North Africa and South Asia are relatively less numerous than the data for the other regions. We expect the results not to be significant for these two regions.

As table 4.3 shows, a higher percentage of the firms are in 4th level of exports. The percentage is significantly higher in *East Asia & pacific* (%46), *Middle East & North Africa* (58%), and *South Asia* (53%).

4.4.1 Ordinal Logistic Regression

Since the NTBs contain ordered categorical values, it may be useful to calculate their predicted probability of being *ranked as a barrier.*

Table 4.3: Descriptive statistics

Region	expoProb	1	2	3	4	Total
eastAsia&Pacific		376	377	169	780	1702
		(22%)	(22%)	(10%)	(46%)	
Europe&CentralAsia		1168	852	349	929	3298
		(35%)	(26%)	(10%)	(29%)	
LatinAmerica&Caribb		1312	815	333	686	3146
ean		(42%)	(26%)	(10%)	(22%)	
MiddleEast&NorthAfr		90	51	40	246	427
ica		(21%)	(12%)	(9%)	(58%)	
SouthAsia		76	90	50	244	460
		(16%)	(19%)	(12%)	(53%)	
subSaharanAfrica		431	324	127	352	1234
		(35%)	(26%)	(10%)	(29%)	
Total		3453	2509	1068	3236	10266

Table 4.4: Predicted probabilities

	0	1	2	3	4
NTB1	0.3796	0.2194	0.2107	0.11392	0.07644
NTB2	0.22084	0.1722	0.2625	0.21104	0.13344
NTB3	0.2925	0.2104	0.2733	0.14398	0.07983
NTB4	0.4240	0.2146	0.2136	0.18677	0.11439

Table 4.4 shows that, keeping other categories to their means, NTB2 has the highest (13%) probability to be ranked as obstacle to trade.

Interestingly, NTB4 has an 11% probability to be ranked as a very severe obstacle. However, NTB4 has a 42% probability to be ranked as 0 (not an obstacle), which shows the weight of ranking the NTB is not parallel when we move from a category to another. The assumption underlying the ordinal logistic regression (OLR) is that the relationship between each pair of the outcome group is the same. This is called the proportional assumption or the parallel regression assumption (Harrell, 2001).

Harrell recommends a graphical method for assessing the parallel slopes assumption. The values displayed in following graphs are essentially (linear) predictions from logit models, used to model the probability that the dependent variables (NTB_k) are greater than or equal to a given value (for each level of the dependent variable), using one predictor (the independent variable) variable at a time. We conduct the test in R and the graphs for the NTBs are presented in figures 4.2, 4.3, 4.4, and 4.5. Regarding the parallel regression's assumptions, the markers for each independent variable should be close to each other. The *y* axis values present the values for regions and exports levels as predictor variables, and the x axis values present the difference between the (linear) predicted values, which are results of regressing the dependent variable (NTB_k) on the predictor variables (regions and levels of exports). The linear predicted values are presented in Appendix B.

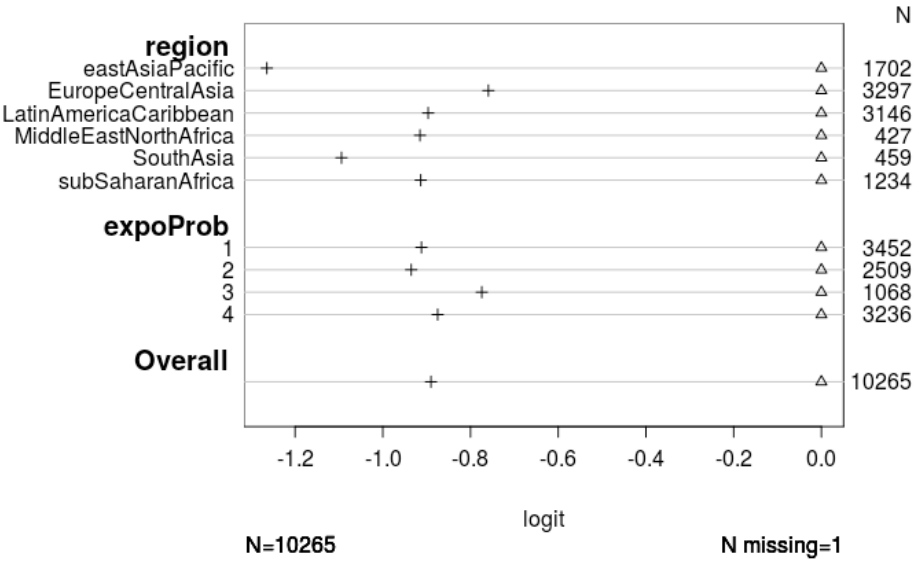

Figure 4.2: NTB1– Proportional assumption

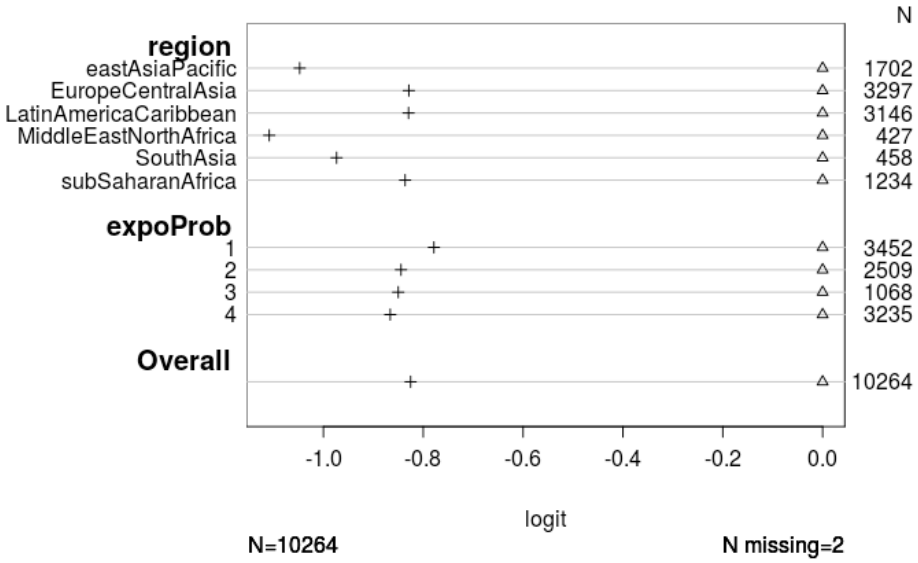

Figure 4.3: NTB2– Proportional assumption

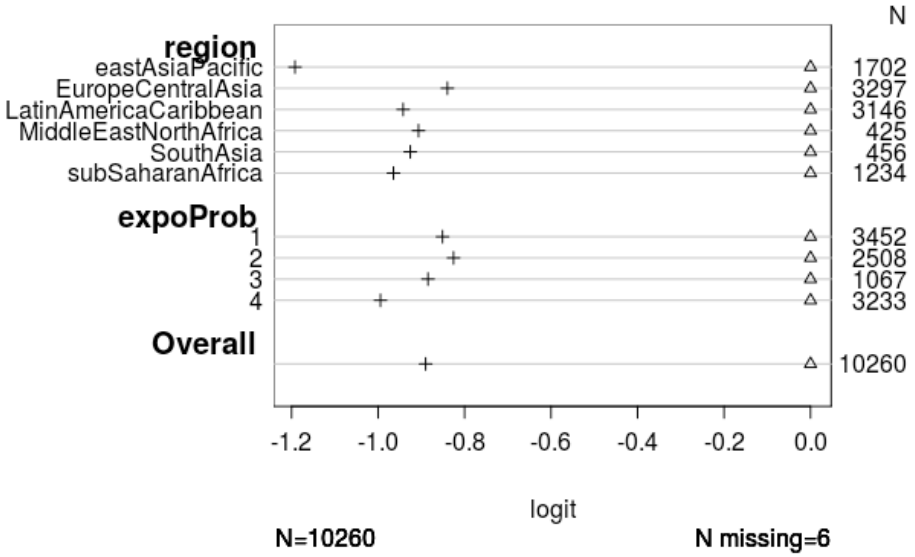

Figure 4.4: NTB3- Proportional assumption

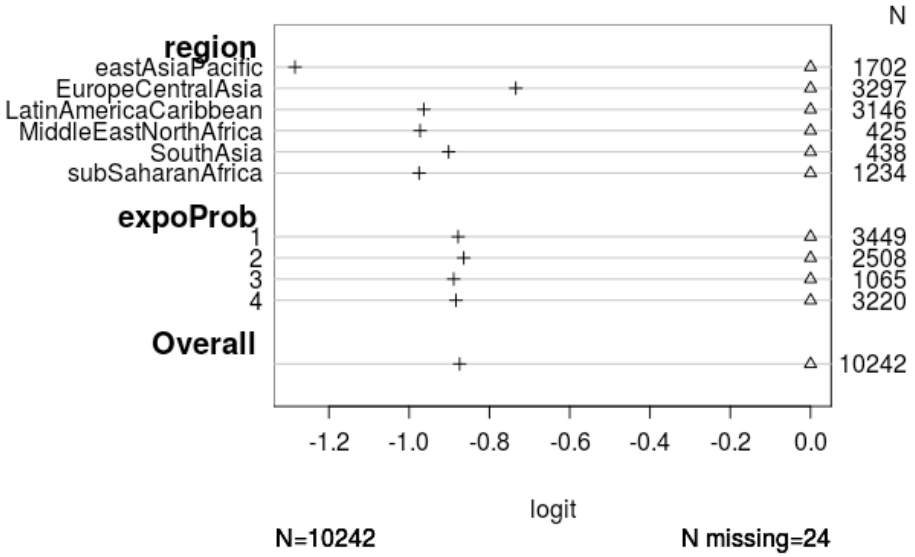

Figure 4.5: NTB4- Proportional assumption

As the figures show, none of the NTBs fulfill the assumption for the OLR. When the markers are not closed to each other, it means that the slope between the categories of regions and the levels of exports are not the same. So the parallel assumption fails. For instance, for the firms in South Asia, the difference between the predicted value to rank NTB2 as moderate obstacle (2) and rank major obstacle (3) is almost 0.973 (1.408 – 0.435), versus in East Asia and Pacific, where the difference is almost 1.052 (0.284 – (-0.768)). This suggests that the parallel slopes assumption does not hold for the predictor region.[22]

Therefore, the estimation of choice in this article will not be the ordinal logistic regression estimator, but instead the binary logistic regression estimator.

4.4.2 Binary logistic regression

In order to apply a binary logistic regression, we adjusted the independent variable to a binary variable. As we previously explained, we changed the value of 0 to 3 to value 0, and the value of 4 to value 1. Through the binary logistic regression, we estimate the odd ratios and log-odds.

I) Model with no interaction

At the first step, we estimate the NTBs on only one categorical independent variable (predictor). We select the variable of exports level (expoProb) as the categorical predictor. The results for the NTBs are presented in tables 4.5, 4.6, 4.7, and 4.8. Table 4.5 shows that the odds to rank NTB1 as a very sever barrier is 1.1 time higher for the firm in the 3rd level of exports (51-75%). Table 4.6 shows negative log odds that NTB2 be ranked as a severe barrier. The result is similar for NTB3 in table. Finally, table 4.8 shows that the odds of the NTB4 be ranked as a very severe barrier is 10% higher for the firm in the 3rd level of exports than the other categories. The constant in the log-odds estimation represents the log-odds of ranking NTBs as a severe barrier by firms in *expoProb1*(10-25%). For example, the constant of the log-odds estimation in table 4.8 represents the log odds of ranking NTB4 for firm in *expoProb1* (-2.87).

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[22] The coefficients calculated through the regression equation of dependent variables NTBs on predictor variables (region and level of exportation) one at the time. The predicted values presented in Appendix B

Table 4.5: Regression result NTB1- customs and trade regulations

Regression Results

	Dependent variable:	
	NTB1	
	Odds ratios	Log odds
	(1)	(2)
expoProb2	0.89*** (0.69, 1.09)	-0.12 (-0.32, 0.09)
expoProb3	1.11*** (0.86, 1.36)	0.10 (-0.15, 0.35)
expoProb4	1.12*** (0.94, 1.30)	0.12 (-0.06, 0.29)
Constant	0.08 (-0.05, 0.21)	-2.51*** (-2.64, -2.39)
Observations	10,266	10,266
Log Likelihood	-2,771.92	-2,771.92
Akaike Inf. Crit.	5,551.84	5,551.84

Note: The coefficients are significant and get asterisks as *if P-value <0.1, ** id P-Value<0.05, and *** is P-value<0.01. Binary logistic estimation; all commands and algorithms are coded in $3.4 using GLM package.

Table 4.6: Regression result NTB2 - tax rate

Regression Results

	Dependent variable:	
	NTB2	
	Odds ratios	Log odds
	(1)	(2)
expoProb2	0.76*** (0.61, 0.91)	-0.28*** (-0.43, -0.13)
expoProb3	0.75*** (0.55, 0.96)	-0.28*** (-0.49, -0.08)
expoProb4	0.70*** (0.56, 0.84)	-0.36*** (-0.50, -0.22)
Constant	0.19*** (0.10, 0.28)	-1.67*** (-1.77, -1.58)
Observations	10,266	10,266
Log Likelihood	-4,007.90	-4,007.90
Akaike Inf. Crit.	8,023.79	8,023.79

Note: The coefficients are significant and get asterisks as *if P-value <0.1, ** id P-Value<0.05, and *** is P-value<0.01. Binary logistic estimation; all commands and algorithms are coded in $3.4 using GLM package.

The second step is to add the variable. This variable is a categorical predictor that includes 6 regions. Tables 4.9, 4.10, 4.11, and 4.12 show the results of binary logistic estimation, including odds ratios and log-odds for each NTBs. Export level 1 (10-25%) is the reference category for *expoProb* variable and region *East Asia & Pacific* is the reference for variable *region*.

Table 4.9 shows the result for NTB1: customs and trade regulations. As the table reads, the odds ratio to rank NTB1 as a severe barrier for the Latin America & Caribbean is the highest. The constant of log odds represent the category of expoProb1 and region EastAsia & Pacific. The constant value in table 4.5 and 4.9 represents the log odds for expoProb1, hence the difference in the constants -1.60 [(-4.11 – (-2.51)] represents the log odds for region of EastAsia & Pacific.

Table 4.7: Regression results NTB3- tax administration

Regression Results

	Dependent variable:	
	NTB3	
	Odds ratios	Log odds
	(1)	(2)
expoProb2	0.81^{***} (0.63, 0.99)	-0.21^{**} (-0.39, -0.03)
expoProb3	0.75^{***} (0.49, 1.00)	-0.29^{**} (-0.55, -0.03)
expoProb4	0.64^{***} (0.46, 0.82)	-0.45^{***} (-0.63, -0.27)
Constant	0.11^{*} (-0.01, 0.22)	-2.24^{***} (-2.35, -2.12)
Observations	10,266	10,266
Log Likelihood	-2,843.99	-2,843.99
Akaike Inf. Crit.	5,695.99	5,695.99

Note: The coefficients are significant and get asterisks as *if P-value <0.1, ** id P-Value<0.05, and *** is P-value<0.01. Binary logistic estimation; all commands and algorithms are coded in $3.4 using GLM package.

Table 4.8: Regression results NTB4- business licensing and permit

Regression Results

	Dependent variable:	
	NTB4	
	Odds ratios	Log odds
	(1)	(2)
expoProb2	0.87^{***} (0.63, 1.10)	-0.14 (-0.38, 0.09)
expoProb3	1.10^{***} (0.81, 1.40)	0.10 (-0.20, 0.39)
expoProb4	0.84^{***} (0.61, 1.06)	-0.18 (-0.40, 0.04)
Constant	0.06 (-0.09, 0.20)	-2.87^{***} (-3.01, -2.72)
Observations	10,266	10,266
Log Likelihood	-2,037.66	-2,037.66
Akaike Inf. Crit.	4,083.31	4,083.31

Note: The coefficients are significant and get asterisks as *if P-value <0.1, ** id P-Value<0.05, and *** is P-value<0.01. Binary logistic estimation; all commands and algorithms are coded in $3.4 using GLM package.

Table 4.10 shows that the odds to rate NTB2 as a severe barrier is the highest for the region Middle East & North Africa. The coefficients of odds ratios are significantly large for the other regions except the East Asia & pacific region. The difference between the constants in tables 4.6 and 4.10 suggests that the log odds for region of East Asia & Pacific is – 1.93 [(-3.6 – (-1.67))].

Table 4.11 shows the result of the binary logistic estimation of the NTB 3. The results show that the odds to rate NTB3 as a severe barrier is the highest for the Latin America & Caribbean region. The odds ratios are significantly large for other regions except the region of East Asia & Pacific. The difference between the constants of tables 4.7 and 4.11 suggests that the log odds of the East Asia & Pacific is – 1.82 [(-4.06 – (-2.24))].

Table 4.9: NTB1- customs and trade regulations

Regression Results

	Dependent variable:	
	NTB1	
	Odds ratios	Log odds
	(1)	(2)
expoProb2	0.94*** (0.74, 1.14)	-0.06 (-0.26, 0.14)
expoProb3	1.20*** (0.95, 1.46)	0.19 (-0.07, 0.44)
expoProb4	1.43*** (1.25, 1.61)	0.36*** (0.17, 0.54)
regionEuropeCentralAsia	4.38*** (4.01, 4.75)	1.48*** (1.11, 1.85)
regionLatinAmericaCaribbean	6.84*** (6.47, 7.20)	1.92*** (1.56, 2.29)
regionMiddleEastNorthAfrica	2.01*** (1.41, 2.60)	0.70** (0.10, 1.29)
regionSouthAsia	3.93*** (3.44, 4.42)	1.37*** (0.88, 1.86)
regionsubSaharanAfrica	5.29*** (4.90, 5.69)	1.67*** (1.27, 2.06)
Constant	0.02 (-0.35, 0.39)	-4.11*** (-4.48, -3.74)
Observations	10,266	10,266
Log Likelihood	-2,681.33	-2,681.33
Akaike Inf. Crit.	5,380.65	5,380.65

Note: The coefficients are significant and get asterisks as *if P-value <0.1, ** id P-Value<0.05, and *** is P-value<0.01. Binary logistic estimation; all commands and algorithms are coded in $3.4 using GLM package.

Table 4.10: NTB2 - tax rates

Regression Results

	Dependent variable:	
	NTB2	
	Odds ratios	Log odds
	(1)	(2)
expoProb2	0.80*** (0.65, 0.95)	-0.22*** (-0.38, -0.07)
expoProb3	0.80*** (0.59, 1.00)	-0.23** (-0.43, -0.02)
expoProb4	0.82*** (0.68, 0.97)	-0.19*** (-0.34, -0.05)
regionEuropeCentralAsia	8.76*** (8.42, 9.09)	2.17*** (1.84, 2.50)
regionLatinAmericaCaribbean	8.29*** (7.96, 8.62)	2.12*** (1.78, 2.45)
regionMiddleEastNorthAfrica	9.09*** (8.68, 9.49)	2.21*** (1.80, 2.61)
regionSouthAsia	5.98*** (5.56, 6.40)	1.79*** (1.37, 2.21)
regionsubSaharanAfrica	3.39*** (3.01, 3.77)	1.22*** (0.84, 1.60)
Constant	0.03 (-0.30, 0.36)	-3.60*** (-3.93, -3.27)
Observations	10,266	10,266
Log Likelihood	-3,824.54	-3,824.54
Akaike Inf. Crit.	7,667.08	7,667.08

Note: The coefficients are significant and get asterisks as *if P-value <0.1, ** id P-Value<0.05, and *** is P-value<0.01. Binary logistic estimation; all commands and algorithms are coded in $3.4 using GLM package.

Table 4.11: NTB3 - tax administration

Regression Results

	Dependent variable:	
	NTB3	
	Odds ratios	Log odds
	(1)	(2)
expoProb2	0.87*** (0.68, 1.05)	-0.14 (-0.33, 0.04)
expoProb3	0.81*** (0.56, 1.07)	-0.21 (-0.46, 0.05)
expoProb4	0.81*** (0.63, 1.00)	-0.21** (-0.39, -0.02)
regionEuropeCentralAsia	5.83*** (5.41, 6.24)	1.76*** (1.35, 2.18)
regionLatinAmericaCaribbean	9.04*** (8.63, 9.45)	2.20*** (1.79, 2.61)
regionMiddleEastNorthAfrica	4.75*** (4.20, 5.30)	1.56*** (1.01, 2.11)
regionSouthAsia	3.91*** (3.35, 4.47)	1.36*** (0.80, 1.93)
regionsubSaharanAfrica	4.64*** (4.18, 5.09)	1.53*** (1.08, 1.99)
Constant	0.02 (-0.39, 0.43)	-4.06*** (-4.47, -3.65)
Observations	10,266	10,266
Log Likelihood	-2,741.05	-2,741.05
Akaike Inf. Crit.	5,500.09	5,500.09

Note: The coefficients are significant and get asterisks as *if P-value <0.1, ** id P-Value<0.05, and *** is P-value<0.01. Binary logistic estimation; all commands and algorithms are coded in $3.4 using GLM package.

Table 4.12: NTB4 -Business licensing and permits

Regression Results

	Dependent variable:	
	NTB4	
	Odds ratios	Log odds
	(1)	(2)
expoProb2	0.92*** (0.69, 1.16)	-0.08 (-0.32, 0.16)
expoProb3	1.17*** (0.88, 1.47)	0.16 (-0.14, 0.46)
expoProb4	0.97*** (0.74, 1.20)	-0.03 (-0.26, 0.20)
regionEuropeCentralAsia	8.64*** (8.02, 9.25)	2.16*** (1.54, 2.77)
regionLatinAmericaCaribbean	11.38*** (10.77, 11.99)	2.43*** (1.82, 3.04)
regionMiddleEastNorthAfrica	15.41*** (14.73, 16.09)	2.73*** (2.06, 3.41)
regionSouthAsia	7.71*** (6.98, 8.44)	2.04*** (1.31, 2.77)
regionsubSaharanAfrica	6.20*** (5.54, 6.86)	1.83*** (1.17, 2.49)
Constant	0.01 (-0.60, 0.62)	-5.02*** (-5.63, -4.41)
Observations	10,266	10,266
Log Likelihood	-1,966.20	-1,966.20
Akaike Inf. Crit.	3,950.40	3,950.40

Note: The coefficients are significant and get asterisks as *if P-value <0.1, ** id P-Value<0.05, and *** is P-value<0.01. Binary logistic estimation; all commands and algorithms are coded in $3.4 using GLM package.

Table 4.12 shows that the odds to rate NTB4 as a severe barrier is the highest for the *Middle East & North Africa* region. The odds ratios are significantly large for the other regions except the *East Asia & Pacific* region. The difference between the constants of tables 4.8 and 4.12 suggests that the log odds of the *East Asia & Pacific* region is – 2.15 [-5.02 – (-1.67)].

To conclude, the odds to rank NTB2 and NTB4 as a severe barrier are larger for the firms in the *Middle East & North Africa* region, and the odds to rank NTB1 and NTB3 as a severe barrier are larger for the firms in the *Latin America & Caribbean* region.

II) Model with Interaction

The next step is to explore the interaction of two variables: expoProb and region. First, we have to examine if adding the interaction will improve the models or not. For this matter, we calculate the deviance, which is the distance between two probabilistic models.[23] As it showed in table 4.13a, the deviances of all NTBs decrease after adding the interaction variable.

Table 4.13a: Deviances (NTB1- NTB4)

	Deviance original model	Deviance model with interaction	difference
NTB1	29790.62	29745.68	44.935
NTB2	31398.08	31310.35	87.7326
NTB3	30455.38	30410.2	45.1763
NTB4	28076.41	28053.08	23.3323

Hence, it worth to add the expoProb:region variable to the model. As alternative approach, we refit the model with the interaction variable and compare the log-likelihood.

[23] It amounts to two times the log ratio of likelihoods between two nested models

Table 4.13b: log-likelihood

	Loglikelihood original model/df	Loglikelihood model with interaction/df	difference
NTB1	-14895.31	-14872.84	44.935
	df 12	df 27	df 27
NTB2	-15699.04	-15655.17	87.7326
	df 12	df 27	df 27
NTB3	-15227.69	-15205.1	45.1763
	df 12	df 27	df 27
NTB4	-14038.21	-14026.54	23.3323
	df 12	df 27	df 27

As illustrated in table 4.13.b, the model with an interaction between regions and level of exports gives better results. We added the variable *expoProb:region* and the results are presented in tables 4.14 to 4.17.

Table 4.14 presents the results of the odds ratio and log-odds for the NTB1: *customs and trade regulation*. The results show, keeping all the other variables constant, the odds to rank NTB1 as a severe barrier is 126% more for the firms in 2nd level (26-50%) of exports in the *Middle East & North Africa* region. The coefficient is significant. Similarly, the odds are significantly positive for firms in 2nd level of export in regions of the *Sub-Saharan Africa* and *Europe & Central Asia* region. In addition, the odds to rank NTB1 as a severe barrier is 2% less for the firms in the 4th level (76-100%) of exports in the *Sub-Saharan Africa*.

Table 4.14: NTB1 – Customs and trade regulation

	Dependent Variables	
	NTB1	
	Odds Ratios (1)	Log odds (2)
expoProb2	0.80 (-0.53, 2.12)	-0.23 (-1.55, 1.09)
expoProb3	1.88*** (0.47, 3.13)	0.59 (-0.74, 1.91)
expoProb4	1.95*** (0.96, 2.94)	0.67 (-0.32, 1.66)
Region Europe Central Asia	5.46*** (4.54, 6.37)	1.70*** (0.79, 2.61)
Region Latin American Caribbean	8.65*** (7.75, 9.55)	2.16*** (1.26, 3.06)
Region Middle East & North Africa	1.69** (0.03, 3.34)	0.52 (-1.13, 2.18)
Region South Asia	8.73*** (7.58, 9.88)	2.17*** (1.02, 3.31)
Region Sub-Saharan Africa	4.96*** (3.99, 5.92)	1.60*** (0.64, 2.57)
expoProb2: Region Europe Central Asia	1.18* (-0.19, 2.55)	0.17 (-1.20, 1.53)
expoProb3: Region Europe Central Asia	0.56 (-0.85, 1.97)	-0.58 (-1.99, 0.83)
expoProb4: Region Europe Central Asia	0.73 (-0.31, 1.77)	-0.32 (-1.35, 0.72)
expoProb2: Region Latin American Caribbean	1.03 (-0.33, 2.39)	0.03 (-1.33, 1.38)
expoProb3: Region Latin American Caribbean	0.69 (-0.69, 2.07)	-0.37 (-1.75, 1.00)
expoProb4: Region Latin American Caribbean	0.71 (-0.32, 1.73)	-0.35 (-1.37, 0.68)
expoProb2: Region Middle East & North Africa	2.26* (-0.13, 4.65)	0.81 (-1.58, 3.20)
expoProb3: Region Middle East & North Africa	1.29 (-1.11, 3.69)	0.25 (-2.14, 2.65)
expoProb4: Region Middle East & North Africa	1.05 (-0.76, 2.87)	0.05 (-1.76, 1.87)
expoProb2: Region South Asia	0.76 (-0.96, 2.49)	-0.27 (-1.99, 1.45)
expoProb3: Region South Asia	0.41 (-1.42, 2.24)	-0.89 (-2.72, 0.94)
expoProb4: Region South Asia	0.31 (-1.02, 1.64)	-1.19* (-2.52, 0.14)
expoProb2: Region Sub-Saharan Africa	1.99*** (0.56, 3.42)	0.69 (-0.74, 2.12)
expoProb3: Region Sub-Saharan Africa	0.87 (-0.64, 2.37)	-0.14 (-1.65, 1.36)
expoProb4: Region Sub-Saharan Africa	0.98* (-0.13, 2.09)	-0.02 (-1.13, 1.09)
Constant	0.01 (-0.87, 0.90)	-4.31*** (-5.19, -3.42)
Observation	10,266	10,266
Log Likelihood	-2,675.96	-2,675.96
Akaike Inf. Crit.	5,399.92	5,399.92

Note: The coefficients are significant and get asterisks as * if P-Value<0.1, ** if P-Value<0.05, and *** if P-Value<0.01. Binary logistic estimation; all commands and algorithms are coded in R3.4 using GLM package.

The probability of ranking NTB1 as a severe barrier decreases for the firms with a higher level of exports. For instance, firms in the *Middle East* and *North Africa* (and similarly in other regions), in the 2nd level of exports are more likely to rank NTB1 as severe barriers than firms in 3rd and 4th levels of exports.

Table 4.15: NTB2 - tax rate

	Dependent Variables	
	NTB2	
	Odds Ratios	Log odds
	(1)	(2)
expoProb2	0.90* (-0.02, 1.81)	-0.11 (-1.02, 0.80)
expoProb3	0.44 (-1.09, 1.97)	-0.82 (-2.35, 0.70)
expoProb4	0.86** (0.08, 1.65)	-0.15 (-0.93, 0.64)
Region Europe Central Asia	8.64*** (7.99, 9.28)	2.16*** (1.51, 2.80)
Region Latin American Caribbean	8.96*** (8.32, 9.60)	2.19*** (1.55, 2.84)
Region Middle East & North Africa	7.91*** (7.08, 8.74)	2.07*** (1.24, 2.90)
Region South Asia	7.55*** (6.69, 8.42)	2.02*** (1.16, 2.89)
Region Sub-Saharan Africa	2.25*** (1.51, 3.00)	0.81** (0.07, 1.56)
expoProb2: Region Europe Central Asia	0.69 (-0.25, 1.64)	-0.36 (-1.31, 0.58)
expoProb3: Region Europe Central Asia	1.93** (0.37, 3.49)	0.66 (-0.90, 2.22)
expoProb4: Region Europe Central Asia	1.20*** (0.39, 2.02)	0.19 (-0.63, 1.00)
expoProb2: Region Latin American Caribbean	0.95** (0.01, 1.89)	-0.05 (-0.99, 0.89)
expoProb3: Region Latin American Caribbean	1.38* (-0.18, 2.95)	0.32 (-1.24, 1.89)
expoProb4: Region Latin American Caribbean	0.69 (-0.14, 1.51)	-0.38 (-1.20, 0.45)
expoProb2: Region Middle East & North Africa	1.77*** (0.53, 3.00)	0.57 (-0.66, 1.80)
expoProb3: Region Middle East & North Africa	4.00*** (2.24, 5.76)	1.39 (-0.38, 3.15)
expoProb4: Region Middle East & North Africa	0.89* (-0.13, 1.90)	-0.12 (-1.14, 0.90)
expoProb2: Region South Asia	0.68 (-0.60, 1.95)	-0.39 (-1.66, 0.88)
expoProb3: Region South Asia	1.51 (-0.34, 3.36)	0.41 (-1.44, 2.26)
expoProb4: Region South Asia	0.70 (-0.37, 1.76)	-0.36 (-1.42, 0.70)
expoProb2: Region Sub-Saharan Africa	1.92*** (0.86, 2.98)	0.65 (-0.41, 1.72)
expoProb3: Region Sub-Saharan Africa	3.87*** (2.18, 5.55)	1.35 (-0.34, 3.04)
expoProb4: Region Sub-Saharan Africa	1.44*** (0.47, 2.41)	0.36 (-0.61, 1.33)
Constant	0.03 (-0.60, 0.66)	-3.60*** (-4.23, -2.97)
Observation	10,266	10,266
Log Likelihood	-3,803.61	-3,803.61
Akaike Inf. Crit.	7,655.22	7,655.22

Note: The coefficients are significant and get asterisks as * if P-Value<0.1, ** if P-Value<0.05, and *** if P-Value<0.01. Binary logistic estimation; all commands and algorithms are coded in R3.4 using GLM package.

In other words, customs and trade regulation are more likely to be ranked as a severe obstacle by the firms in lower levels of exports. Customs and trade regulations can be imposed by home and destination countries and according to the results, it may have discouraging impacts on firms with smaller share of exports.

Table 4.16: NTB3 - tax administration

	Dependent Variables	
	NTB3	
	Odds Ratios	Log odds
	(1)	(2)
expoProb2	0.57(-0.67, 1.80)	-0.57 (-1.81, 0.67)
expoProb3	0.31 (-1.79, 2.42)	-1.16 (-3.26, 0.94)
expoProb4	0.89* (-0.03, 1.82)	-0.11 (-1.04, 0.81)
Region Europe Central Asia	4.56*** (3.78, 5.34)	1.52*** (0.74, 2.29)
Region Latin American Caribbean	8.65*** (7.89, 9.42)	2.16*** (1.39, 2.92)
Region Middle East & North Africa	5.14*** (4.10, 6.19)	1.64*** (0.60, 2.68)
Region South Asia	5.35*** (4.27, 6.43)	1.68*** (0.60, 2.76)
Region Sub-Saharan Africa	4.37*** (3.54, 5.20)	1.47* (0.65, 2.30)
expoProb2: Region Europe Central Asia	1.52** (0.24, 2.80)	0.42 (-0.86, 1.70)
expoProb3: Region Europe Central Asia	2.97*** (0.81, 5.12)	1.09 (-1.06, 3.24)
expoProb4: Region Europe Central Asia	1.44*** (0.47, 2.42)	0.37 (-0.61, 1.34)
expoProb2: Region Latin American Caribbean	1.54** (0.28, 2.81)	0.43 (-0.83, 1.70)
expoProb3: Region Latin American Caribbean	2.58** (0.44, 4.71)	0.95 (-1.19, 3.08)
expoProb4: Region Latin American Caribbean	0.68 (-0.30, 1.65)	-0.39 (-1.37, 0.59)
expoProb2: Region Middle East & North Africa	3.37*** (1.75, 4.99)	1.22 (-0.40, 2.84)
expoProb3: Region Middle East & North Africa	2.65*** (0.13, 5.17)	0.97 (-1.54, 3.49)
expoProb4: Region Middle East & North Africa	0.44 (-0.92, 1.79)	-0.83 (-2.18, 0.52)
expoProb2: Region South Asia	0.60 (-1.26, 2.46)	-0.51 (-2.37, 1.35)
expoProb3: Region South Asia	2.01 (-0.52, 4.53)	0.70 (-1.83, 3.22)
expoProb4: Region South Asia	0.57 (-0.77, 1.91)	-0.56 (-1.90, 0.78)
expoProb2: Region Sub-Saharan Africa	1.71** (0.35, 3.06)	0.53 (-0.82, 1.89)
expoProb3: Region Sub-Saharan Africa	2.24* (-0.02, 4.51)	0.81 (-1.46, 3.07)
expoProb4: Region Sub-Saharan Africa	0.73 (-0.37, 1.83)	-0.32 (-1.42, 0.78)
Constant	0.02 (-0.73, 0.77)	-3.96*** (-4.71, -3.22)
Observation	10,266	10,266
Log Likelihood	-2,726.57	-2,726.57
Akaike Inf. Crit.	5,501.15	5,501.15

Note: The coefficients are significant and get asterisks as * if P-Value<0.1, ** if P-Value<0.05, and *** if P-Value<0.01. Binary logistic estimation; all commands and algorithms are coded in R3.4 using GLM package.

Table 4.17: NTB4 - business licensing and permits

	Dependent Variables	
	NTB4	
	Odds Ratios (1)	Log odds (2)
expoProb2	0.25(-1.95, 2.44)	-1.40 (-3.59, 0.80)
expoProb3	0.0000 (-361.77, 361.77)	-12.03 (-373.81,349.74)
expoProb4	0.72 (-0.55, 1.99)	-0.33 (-1.60, 0.94)
Region Europe Central Asia	4.86*** (3.84, 5.88)	1.58*** (0.56, 2.60)
Region Latin American Caribbean	7.01*** (6.01, 8.02)	1.95** (0.94, 2.96)
Region Middle East & North Africa	18.60*** (17.47, 19.73)	2.92*** (1.79, 4.05)
Region South Asia	5.17*** (3.76, 6.58)	1.64** (0.23, 3.05)
Region Sub-Saharan Africa	2.89*** (1.76, 4.02)	1.06* (-0.07, 2.19)
expoProb2: Region Europe Central Asia	3.91*** (1.68, 6.15)	1.36 (-0.87, 3.60)
expoProb3: Region Europe Central Asia	237,843.90*** (237,482.10, 238,205.70)	12.38 (-349.39, 374.15)
expoProb4: Region Europe Central Asia	1.61** (0.28, 2.94)	0.47 (-0.85, 1.80)
expoProb2: Region Latin American Caribbean	4.18*** (1.96, 6.41)	1.43 (-0.79, 3.65)
expoProb3: Region Latin American Caribbean	181,146.70*** (180,784.90, 181,508.50)	12.11 (-349.67, 373.88)
expoProb4: Region Latin American Caribbean	1.20* (-0.13, 2.53)	0.18 (-1.14, 1.51)
expoProb2: Region Middle East & North Africa	2.20* (-0.25, 4.64)	0.79 (-1.66, 3.23)
expoProb3: Region Middle East & North Africa	44,287.95*** (43,926.17, 44,649.73)	10.70 (-351.08, 372.47)
expoProb4: Region Middle East & North Africa	0.51 (-0.96, 1.99)	-0.66 (-2.14, 0.81)
expoProb2: Region South Asia	1.65 (-1.14, 4.45)	0.50 (-2.29, 3.30)
expoProb3: Region South Asia	126,220.70*** (125,858.90, 126,582.40)	11.75 (-350.03, 373.52)
expoProb4: Region South Asia	1.52* (-0.19, 3.23)	0.42 (-1.29, 2.13)
expoProb2: Region Sub-Saharan Africa	4.14*** (1.79, 6.49)	1.42 (-0.93, 3.77)
expoProb3: Region Sub-Saharan Africa	462,504.80*** (462,143.00, 462,866.60)	13.04 (-348,374.82)
expoProb4: Region Sub-Saharan Africa	1.99*** (0.51, 3.46)	0.69 (-0.79, 2.16)
constant	0.01 (-0.97, 1.00)	-4.53*** (-5.52, -3.55)
Observation	10,266	10,266
Log Likelihood	-1,955.51	-1,955.51
Akaike Inf. Crit.	3,959.03	3,959.03

Note: The coefficients are significant and get asterisks as * if P-Value<0.1, ** if P-Value<0.05, and *** if P-Value<0.01. Binary logistic estimation; all commands and algorithms are coded in R3.4 using GLM package.

Table 4.15 presents the results for NTB2: tax rate. The tax rate mostly refers to charges on imports issued by governments of importing countries.

The results show, keeping all the other variables constant, the odds to rank NTB2 as a severe barrier is 300% more for the firms in the 3rd level (51-75%) of exports in the Middle East & North Africa region. The coefficient is significant and the largest coefficient among others. Similarly, the odds are significantly positive (and large) for firms in the 3rd level of exports in the Sub-Saharan Africa region (287%). In addition, there are negative odds ratios. For example, the odds to rank NTB2 as a severe barrier is 11% less for the firms in the 4th level (76-100%) of exports in the Middle East & North Africa.

In general, the probability of ranking NTB2 as a severe barrier decreased for the firms with higher level of exports. For instance, firms in Europe & central Asia in the 2nd level of exports are more likely to rank NTB2 as a severe barrier than firms in the 3rd and 4th level of exports. Firms in Europe & Central Asia and in Latin America & Caribbean ranked (corporate) tax rate as a severe barrier. Despite the decline in tax rates over the past decades, evidence show that still firms consider tax rates as severe barrier.[24]

Table 4.16 presents the result of NTB3, *tax administration*. This NTB refers to the process of tax on exportation that a firm has to settle with its own government. The results show, keeping all the other variables constant, the odds to rank NTB3 as a severe barrier are 237% more for the firms in the 2nd level (26-50%) of exports in the *Middle East & North Africa* region. The coefficient is significant and the largest coefficient among others. Similarly, the odds are significantly positive (and large) for firms in the 3rd level of exports in the *Europe & Central Asia* region (297%). Similar to NTB1 and NTB2, the odds are not significant for the *South Asia* region.

The probability of ranking NTB3 as a severe barrier does not have the same trend as NTB1 and NTB2. For instance, firms in *Latin America and Caribbean* (and similarly in other regions), in the 2nd level of exports are more likely to rank NTB1 as a severe barrier than firms in the 3rd and 4th level of exports.

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[24] In 2016 the tax rates in Europe countries are between 10% and 35%.

Table 4.17 shows the results for NTB4, business licensing and permits. This NTB refers to the barriers that obtaining business license and permits (domestic or international permits) impose on firms. As the table shows, the results are quite different to NTB1, NTB2, and NTB3.[25]

The results show large significant odds to rank NTB4 as a very severe barrier for the firms within the 3rd level of exports in all the regions. The coefficients in Table 4.17 are large and they follow the same trend of relatively large coefficients of Table 4.12 (the model without the interaction variable). The odds are positive and significant for the other levels of export

4.5 Robustness check

In order to evaluate the robustness of the model, we first changed the categories of exports levels from 4 categories to 2 categories: 10-50% and 51-100%, and to 5 levels: 10-20%, 21-40%, 41-60%, 61-80%, 81-100%.

Then the results of both generated categories are compared. About the results of the model with 2 categories of exports levels, the coefficients are very similar with the model with 4 categories; however, just a few of the coefficients remain significant. The noticeable change is in the coefficients of the interaction variables of NTB4.

Furthermore, the model with 5 levels of exports produces the results with the same slopes (increasing or decreasing) as the model with 4 levels of exportation.

4.6 Conclusion

Non-tariff barriers (NTBs) are expected to improve social welfare through removing market failures (Chen and Mattoo, 2008). However, the impacts of non-tariff barriers are not the same across countries. For example, NTBs reduce the exports from developing countries to developed

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[25] The result presented in table 4.15 is similar to the result of table 4.10 (model with no interaction) which shows large odd ratios for NTB4 comparing to NTB1, NTB2, and NTB3.

countries (Disdier et al., 2008). In this article, we propose an analysis of the data from Enterprise Surveys answered by firms in developing or least developed countries (upper middle, lower middle, and low income countries). The main goal is to compare the severity of NTBs in different levels of engagement in international markets and in various regions, from firms' view. We selected 4 NTBs regarding the World Bank Enterprise Surveys. The results showed not all the firms rank the NTBs similarly.

The predicted probabilities show that NTBs: *tax rate* (NTB2) and *business licensing and permits* (NTB4) are more likely to be rated as a severe barrier (rated as 4). The NTBs: *tax administration* (NTB3) and *customs and trade regulation* (NTB1) are more probable to be ranked as minor or no obstacle to trade.

In addition, we adjusted the NTBs to binary variable by giving the value of 1 to severe obstacles (value 4) and 0 to the other categories (0, 1, 2, and 3), and we estimate the odds for different levels of exports across different regions. The NTBs: *business licensing and permits* (NTB4) and tax rate (NTB2) are more likely to be ranked as a severe barrier for the firms with 51-75% level of exports. This suggests that firms in higher levels of exports have to challenge more with these NTBs. We assume the barrier make them not to be able to use their full capacity to export. The majority of the firms with 26-50% of exports are more likely to rank *tax administration* (NTB3) as a severe barrier (significant for 4 regions). This result is similar to *customs and trade regulation* (significant for 2 regions).

As the majority of the international trade agreements aims to facilitate imports and exports in magnitude levels, it seems there are many countries that may need some adjustments. This article sheds some new light on the role played by NTBs. In particular, it does so by using firm-level data. Instead of using macroeconomic categories, we perform our analysis by using top managers' responses.

The results may be interesting to draw some policy lessons for governments, international trade negotiators, and international organizations interested in the economic development of emerging countries and LDCs.

CHAPTER 5 ARTICLE 2: TECHNICAL BARRIERS TO TRADE: A EUROPEAN CASE STUDY

Abstract[26]

This article is about the impact of Technical Barriers to trade (TBTs) on trade between developed and emerging countries. To address this question, we built an original database including the imports in agriculture and industrial sectors from China (emerging country) and the United States of America (developed country) to the member states of the European Union from 2001 to 2015. The findings confirm that trade impacts of TBTs with dissimilar primary objective, is not the same. For instance, TBT notifications of *protection of human and health or safety* has positive impacts on imports in agricultural sectors China and US, while the TBT notifications of *protection of the environment* and the TBT notifications of *quality requirements* create barriers on imports in industrial sectors from the US.

Keywords: Technical Barriers to Trade; European Union; TBTs categories; agricultural sectors; industrial sectors.

[26] Farnia, F., de Marcellis-Warin, N., Warin, T., (2018). Journal of Economic Integration. (Submitted)

5.1 Introduction

Despite recent trade agreements, technical assistance, and mutual recognition agreements, technical barriers are still a challenging subject in international trade (Calvin & Krissoff 1998; Roberts et al. 1999; Liu and Yue 2009). The literature is extensive with several studies on the impacts of technical barriers to trade (TBTs) on imports, exports, welfare, market failures and innovation with both global and local dimensions (Bao and Qui 2012). The technical barriers seem to affect agricultural products more than industrial products, labor-intensive products more than capital-intensive products, and developing countries more than developed countries. However, the complicated and evolving nature of TBTs requires more studies on this topic.

The majority of studies on TBTs is about their impacts on trade either in different sectors - for instance agricultural versus industrial (for example, Fontagné et al. 2005 and Yoon et al. 2014) - or on a specific product. In this article, our contribution is both thematic and methodological. we compare the trade impacts of TBTs differentiated by categories, based on the World Trade Organization (WTO) classification. The categories are based on the primary objective of TBTs and include (but are not limited to): “protection of human and health or safety”, “prevention of deceptive practices and consumer protection”, “protection of the environment”, “quality requirements”, “consumer information”, “labeling” (see WTO TBT Agreement).[27] However, the number of issued notifications under each objective varies significantly. For example, by the end of 2016, the number of issued TBT notifications in the category of “protection of human health or safety” is 8144 versus the number of issued notifications under the category of “Protection of animal or plant life”, which is 329 [Figure 5.1].

[27] For further information, see TBT agreement on:
https://www.wto.org/english/docs_e/legal_e/17-tbt.pdf

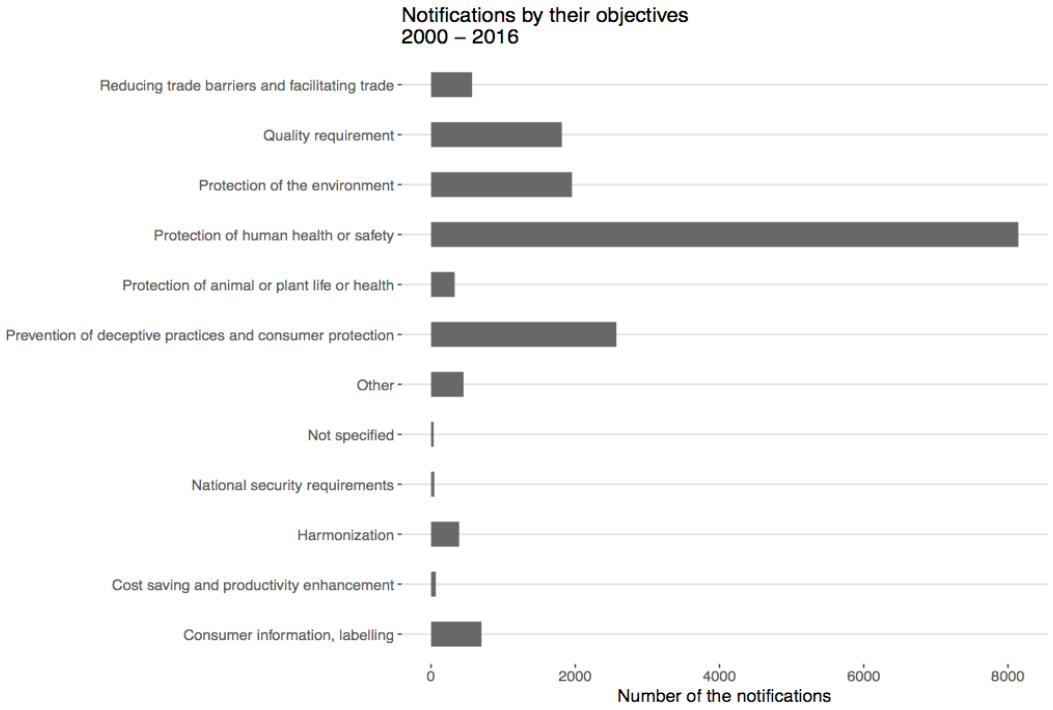

Figure 5.1: TBT notifications issued in WTO TBT Agreement (1995-2016). Source: WTO TBT Information Management System.

This article confirms that the impacts of the TBTs vary across the categories (primary objective). For example, the TBTs in the "protection of human and health or safety" category have a different impact that the TBTs in the "quality requirements" category. To the best of our knowledge, this is one of the first studies using different TBTs categories. As the concerns on welfare and trade impacts of such barriers increased recently, this article aims to investigate the trade impacts of three large categories on TBTs: (1) "protection of human and health or safety", (2) "protection of the environment", and (3) "quality requirements". We selected two countries, the US and China, as examples of developed and emerging countries. China and the US offer ideal setting to study the impacts of TBTs on exports to the EU.

The US is the largest EU partner for exports in 2016. The EU countries, together, would rank first as an export market for the US in 2016. Also in 2016, the EU countries together would rank 4th as an agricultural export market for the US. For the last twenty years China's foreign trade has expanded at an outstanding pace (almost 15% per year) and its share in world trade has more than trebled, from less than 1% to about 3.5%.

China is the top EU partner for imports in 2016. In addition to the large volume of Chinese trade. There are other factors that make us choose China. For instance, China is one of the largest recipients of NTBs. In 2012, China was involved in 77 cases of trade disputes initiated by 21 countries, and the amount of money involved accounted for more than 28 billion USD (Lu et al., 2014). Also, significant numbers of Chinese have been influenced by TBTs in different forms. In 2013, among 3,152 randomly surveyed export firms from 31 Chinese provinces, 38% reported that they were subject to or influenced by TBTs. (Hu et al., 2017).

The collected data covers period of 2001 to 2015. As the WTO TBT Agreement came inforce in 2008, we compare the result of before and after 2008. Moreover, we compare the impacts of issued TBTs in agriculture versus the industrial sectors.

5.2 Background

TBTs are one of the three sections among the technical measures in NTBs. In general, TBTs are measures that refer to “labeling”, “standards on technical specifications”, “quality requirements”, and other measures protecting “the environment”. TBTs also include all conformity-assessment measures related to technical requirements, such as “certification”, “testing” and “inspection”. The United Nations Organization (UN) has defined technical regulations and conformity assessment regulations as follows:

“A technical regulation is a document that lays down product characteristics or their related processes and production methods, including the applicable administrative provisions, with which compliance is mandatory. It may also include or deal exclusively with terminology, symbols, and packaging, marking or labeling requirements as they apply to a product, process or production method.

A conformity assessment procedure is any procedure used, directly or indirectly, to determine that relevant requirements in technical regulations or standards are filled; it may include, inter alia, procedures for sampling, testing and inspection; evaluation, verification and assurance of conformity; registration, accreditation and approval as well as their combinations.”

The WTO created a protocol on TBTs, which obliges all its members to abide by the same technical regulations. This TBT agreement has several articles concerning the process of preparation, adoption, and application of technical regulations and compliance procedures.

Central and local governmental and non-governmental bodies can apply this TBT agreement. The WTO committee recognized that some developing countries may face some difficulty in the adoption and application of the technical regulations. The TBT agreement binds all members to offer technical assistance for other members on mutually agreed terms and conditions. Moreover, the TBT agreement, in case of a dispute between members, offers consultations and settlement options to its members. The WTO TBT agreement database, which is available online on the WTO website, collected TBTs that have been issued since 2008, mentioning their primary objectives, date and country of issuance.

Bao and Qiu (2012) estimate the trade impacts of TBTs based on all the TBT notifications from the 105 WTO countries between 1995 and 2008. It was found that a country's TBT notifications decreased other countries' probability of exporting, but increased their exports volume. The TBT's differential effects on the fixed and variable costs of exports can explain these results. They concluded that, (1), a developed country's TBTs have significant effects on the exports from both developed and developing countries, (2), a developing country's TBT have significant effects on other developing countries 'exports, but no significant effects on the exports of developed countries, and (3), exports from developed countries are affected by developed country's TBTs more seriously than a developing country's TBTs. The results demonstrate that the impacts of TBTs vary across countries. Therefore, we selected the US as a developed country and China as a developing country, and we compared the results of TBTs impacts with each other. The US and China are the first two largest importing countries to the EU. Among the major export markets studied, the EU is the export market whose technical regulations are most widely perceived to be important, followed by the US (Wilson and Otsuki 2004).

5.2.1 European Union

After the Second World War, in 1958, six European countries established a cooperation aiming (also) at trade without or with lower disputes. The agreement called "European Economic Community" (EEC) included: Belgium, Germany, France, Italy, Luxembourg and the Netherlands. The main outline was that members of the EEC could become economically interdependent and removing the barriers on trade between each other's. During the years, the EEC cooperation evolved not just by joining other countries in the region but also by adding

more policy areas such as climate, environment, health, external relations and securities. As a result, the EEC has been changed to the European Union (EU) and currently has 28 members.

The EU is the biggest player in global trade. The EU commission represents all the members of the union in WTO and the trade policy made in EU level. The EU cooperates with national governments and the European Parliament in case of adoption of new international regulations.

5.2.2 The EU's approach to TBTs

In order to create a single market among the European countries, removing technical barriers to trade has been considered essential (Brenton 2001). The EU promises that products move freely among its members, but, when a EU exporter aims a non-EU market, it probably faces other technical regulation. The EU community proposes two level of procedure: 2015/1535 procedures inter EU members, and the TBT notification procedure at the global level.

Traditionally, the EU's approaches towards the TBTs are 1) harmonization and 2) mutual recognition agreements. From the early 1960s to the 1980s, the EU adopted a so-called "Old Approach" in order to adopt a harmonization product norm in as much details as possible. The problem of this approach was that it is slow, burdensome and unable to adopt by all sort of products that characterize modern economies (Messerlin 2011). Later, during the1980s, the EU takes a new approach, which limited the harmonization to essential requirements to protect the common public interest in health, safety and the environment (Togan 2015). According to MRA principals, a product lawfully produced in a member country cannot be banned from sale on the territory of another member country, even if they are produced with different specifications. The statistics show a significant improvement of covering products in exchange, by applying this new approach.

For example, the new approach of the European Union determines certain levels of health and safety requirements for a majority of products (Chen and Mattoo 2008). In MRAs, meeting a certain degree of harmonization is the first required condition for members, which has been seen in New Approach of the European Union (health and safety related regulation).

5.2.3 2015/1535 Procedure

According to the 2015/1535 procedures, when an EU member wants to propose new technical regulations, it must first come forward to submit the draft to the Commission. Then, the commission has three months to examine the new notification and respond. The Commission asks other members to submit any comment or opinion about the submitted notification. The EU member that has proposed the notification must answer and clarify the intention of its proposal. This also adds another three months to the procedure. At the end, the EU member should submit the final notification with all the editions it might be required by the Commission and the other EU members. This new notification will be adding to the Technical Regulation Information Database (TRIS).

In case of serious and unforeseeable circumstances, there is an exemption for the three months' standstill period. The Commission decides if the condition of "urgency procedure" applies, they would enforce the notification immediately.

5.2.4 TBT notification Procedure

In order to facilitate the EU members to trade internationally, the EU Commission decided to participate in TBT agreement of WTO. Any communication with TBT committee happens through the EU TBT Enquiry Point. There is a 60 days' period after submitting the notification draft for any comments from other WTO members. Regarding the comments, the notifying member may either change the contents of the draft or postpone the enforcement time. In some cases, the notifying member may also decide to withdraw the notification. WTO TBT Agreement mission include baselines are: 1) to prevent the creation of unnecessary and unjustified technical barriers to international trade; 2) to prevent the adoption of protectionist measures; 3) to encourage global harmonization and mutual recognition of technical standards; 4) to enhance transparency. China, the US and the EU as WTO members, are committed to adopt the TBT notifications based on the TBT agreement.

5.3 The influence of TBTs on Imports from China

China still has a high volume in trade with the European Union and the United States. China is the top EU partner for imports in 2016, accounting for a fifth (20%) of all the EU imports.

China is also the second largest EU partner for exports in 2016 (10% of all exports), after the US. The value of the EU trade balance of goods and services with China in 2016 is € 186 billion (note). The EU's main imports from China are industrial and consumer goods, machinery and equipment, and footwear and clothing.

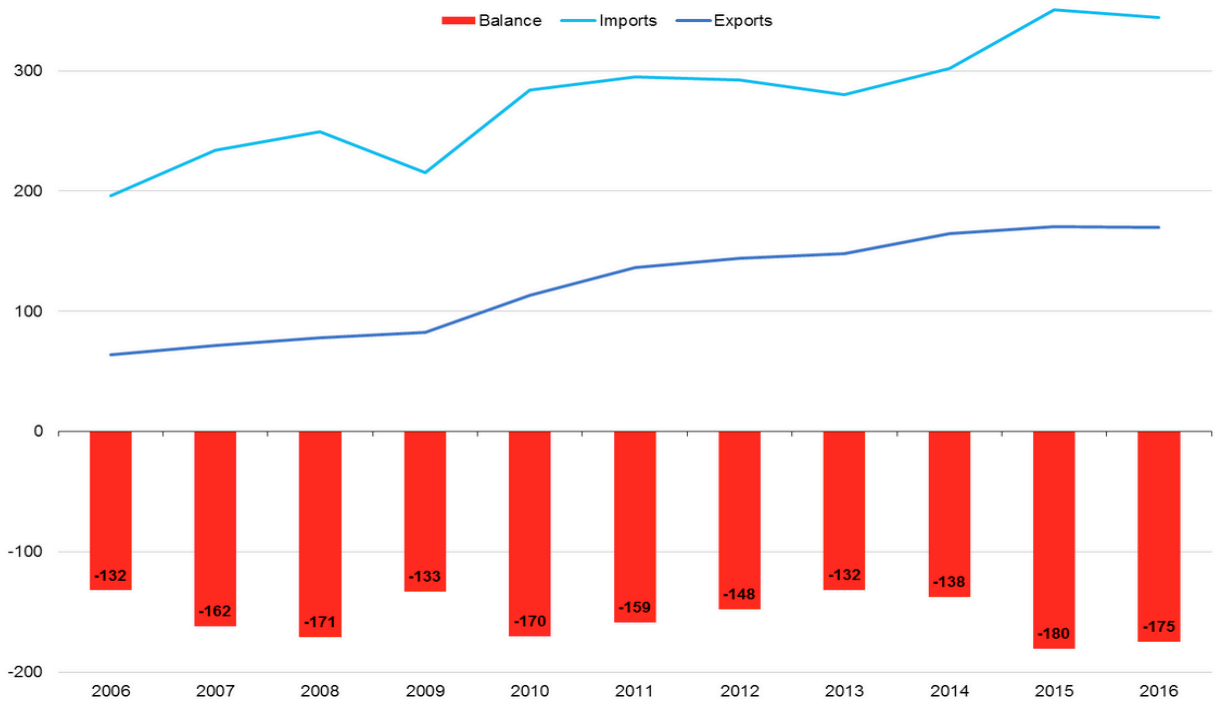

Figure 5.2: Imports from China to the EU (2006-2016). Source : Eurostat database, (ec.europa.eu)

Except for the drop recorded in 2009 as a result of the financial crisis, the value of EU imports of goods from China has almost continuously increased over the last decade to reach 345 billions in 2016. Exports, which did not decline in 2009, have almost tripled between 2006 and 2016, to hit 170 billions last years. The EU trade deficit with China, which persisted over the whole period, reached its peak in 2015 (€180 billions) before decreasing slightly in 2016 (down to €175 billions). However, empirical studies on imports from China to the EU show negative trade impacts of TBTs on trade. For example, a study by Zhang and Liu (2002) on China's exports to the EU and the US shows that TBTs created obstacles for 71% of Chinese corporations with 39% of total exports. Further, Hu et al. (2017) investigate the performance of Chinese firms, which export cigarette lighters to the EU between the years 2004-2008. In fact, they were looking for the result of adoption the "Children-Resistant" (CR) act in the EU. The

result shows that firms adjust their product quality to meet the CR act and upgrade their product quality in other dimensions. However, the export value and volume to the EU decreased.

The high volume of China's trade leads to the fact that the international trade market in China can be easily affected by the TBTs. According to a recent study by Gu (2017), TBTs increase the operating costs of Chinese firms. High-tech enterprises will need more money for research and development to meet the high standards and improve product quality. Then a large part of the revenues will be taken up in research and development. Moreover, technical barriers to trade have changed China’s trade structure, from relying on Europe and USA to Asia and Africa.

5.4 Data and Methodology

The models that used to analyze the trade impacts of TBTs cover almost the full range of methodologies including: firms’ surveys, econometric analysis, general equilibrium studies, and partial equilibrium studies. However, the analyses on TBTs present challenges regarding to their multiple economic effects, which are not easily calculated through a simple increase in the costs of the imported goods. The challenges include (but are not limited to):

. prior to the WTO TBT agreement, some technical standards were discriminatory against importers. Therefore, the price of imported goods is higher than its world level, or that the domestic price.

. technical regulations are (generally) administered as a physical or engineering requirement (in some cases obligatory), not as a cost increase factor.

. implementation of TBTs may impact the consumer decision of the imported product and cause an increase the demand. There, the increase of the price by TBT imposition is compensated by the quantity of the product sold.

Trade impacts of TBTs is quantified either through *ex post* or *ex ante* approaches. The *ex ante* approach refers to simulations with the calculation of tariff equivalents and is usually employed to predict unobserved welfare and impacts. For example, some authors simulate a partial or general equilibrium model to estimate how consumers and producers will respond to the price

change, which are created by the imposition of TBTs (Korinek et al., 2008; Bao and Qiu, 2010). The *ex post* approach includes gravity-based econometric models, which are applied to estimate the trade impacts of TBTs. There are ongoing discussions on the advantages and disadvantages on each of these estimation approaches (Opper et al., 2004; Bao et Qiu, 2010). To select the best approach, there are indicators that should be considered, such as: the accessibility of data and objectives of measurements. Since the aim of this study is to analyze the trade impacts of TBTs, we apply the *ex post* approach.

The most commonly used methodology in the *ex post* approach is the gravity model (equation). Since 1995, the gravity is an important part of international trade. The gravity equation has been recognized because of its consistent empirical success in many types of flows such as migration, commuting, tourism, and commodity shipment (Baier and Bergstrand, 2009).

The majority of scholars applied gravity models to analyze the trade impacts of NTBs (including TBTs). For example, Metha and Nambier (2005) apply a gravity model with the linear-log specification and OLS estimator; Baller (2006) uses a two-stage estimation structure. Stage 1 is a probit gravity equation yielding a proxy for the fraction of firms who decide to export; stage 2 is a standard bilateral trade gravity equation in which the fitted values from stage 1 are used to correct for the heterogeneity bias; Disdier et al. (2005 and 2007) imply a gravity model with the fixed effects for each exporting and importing countries' (multi-resistance term), and sectors' specific fixed effects. Yoann et al. (2014), used a gravity model in the form of generalized two stage least squares. Bao and Qiu (2010, 2012), Siyakiya (2017), Wood et al. (2017) used various forms of gravity model in their research. However, the earlier literature shows other approaches on TBTs.

Since Tinbergen (1962) introduced the gravity equation, several questions about the impacts of mutual borders, cultural and institutional differences, the existence of an ambassador in bilateral trade, environmentally related policies, and different language and currency have been answered by applying third model (Van Bergeijk & Brakman, 2010). According to Anderson and Wincoop (2003), the general concept of gravity model is that the bilateral trade flow is positively affected by economic size, market size, and common language and negatively affected by distance and other multi resistance factors (Siyakiya, 2017). In addition, regarding

limited accessibility of data on technical regulations and standards, gravity model creates a proper approach on quantifying of trade impacts (Kapuya, 2015).

Traditionally, a gravity model implies GDPs as proxies to represent the capability of an exporter (supplier) to all destinations as well as a proxy to analyze the characteristics of the importing (destination) country. In the modern forms of gravity models, GDPs have been replaced by fixed-effects of the importing and exporting countries. Based on the literature, the estimating gravity models containing fixed effects for both side of bilateral trade, is highly recommended (Anderson and Wincoop, 2003). However, when a gravity model applies exporting and importing countries' fixed effects, some of the trade determinants would not be longer valid. For instance, anything that affects exporters' tendency to export, anything that affects imports regardless to the origin of importers, or sum, averages, and differences of country specific variables (Stojkov and Warin, 2018).

Traditionally, the gravity models have been estimated by using Ordinal Least Squares (OLS). The assumption (homoscedasticity assumption) in order to use the OLS techniques is that variance around the regression line is the same for all values of the predictor variable (X). Hence, in the presence of heteroscedasticity, OLS techniques are not consistent (Gomez-Herrera, 2013). Silva and Tenreyro (2006) applied Anderson and Van Wincoop (2003)'s gravity equation, and they highlight that, in the presence of heteroscedasticity, the OLS techniques yield significantly larger effects to the geographical distance. Therefore, even by adding fixed effects, the presence of heteroscedasticity can generate strikingly different estimates. In this case, Poisson Pseudo-Maximum Likelihood (PPLM) is an appropriate alternative to log-linearized OLS for multiplicative models like the gravity equation (Silva and Tenreyro, 2006)

As the literature on gravity model shows, most of the empirical studies have been done with a cross-section framework. However, a panel framework reveals several advantages comparing the cross-section analysis. For example, panels allow to capture the relationship between relevant variables over a longer period. Also within a panel approach one is able to distinguish the time invariant country specific effects (Egger, 2000). In addition, using panel techniques requires the assumption of that the error term is constant across countries or countries-pairs.

The next step of the applied model is the quantification of the variables of TBTs (Bao and Qiu, 2010). There are three sources of information that could be used to measure the regulation as trade barrier: 1) data of regulations, 2) data of frequency of detention, 3) data on complaints from industry against discriminatory regulatory practices and related notifications from international bodies (Beghin and Bureau, 2010).

Swann et al. (1996) use the available information on data by counting the number of voluntary national and international standards. They count the standards recognized by the UK and Germany as indicators of standards over the 1985-1991 period. similarly, Moenius (2004) used the number of regulations by counting the binding standards in a given industry as a measure of stringency of standards. Following them, Siyakiya (2017), Yoon et al. (2014), Bao and Qiu (2012), and Beghin and Bureau (2001) also quantify the TBTs by the total number of TBT notifications to the WTO.

5.4.1 Data

Two databases are created for both: China and the US. One database contains the data on imports from China to the EU members covering the years between 2001 and 2015, in industrial and agricultural sectors. Similarly, another database is created on imports from the US to the individual EU countries. For both databases, the TBT notifications classified by their primary objectives and sectors are included.[28]

The database created based on counting regulation approach, through counting TBTs notification that are issued in WTO TBT Agreement. Each regulation in TBT agreement, include the primary objective (category), and sector of the product that the notification applied. The TBT notifications are classified upon the product sectors they cover. The databases cover 96 classifications on agricultural and industrial products at the HS2-digit level. The products under HS code of 01 to 24 belong to agricultural sectors and the product under HS codes of 24 to 95 belongs to industrial sectors. Therefore, the database includes number of TBTs

[28] TBT notifications are issued during 2001-2015 by WTO TBT agreement. TBT agreement classify the TBT notifications based on the products that they cover (source: http://tbtims.wto.org).

notifications, in 6 categories (primary objectives regarding TBT Agreement), and in two sectors of agricultural and industrial.

Based on the counting approach (data of regulation), the issued TBT notifications are counted as of the 31st of December 2000, and are inserted as value of total TBTs for the year 2001 (accTBT). Then the number of TBTs issued in each year is added to the total TBT notifications (accumulated) until the previous year. Therefore, the value of total TBT notifications for 2015 is equal to all issued notifications by the end of year 2015. The same approach is applied for all categories of TBTs.

As it explained previously, the number of notifications varies across the TBT categories. Hence, we select the three large categories:

TBT1: *protection of human and health or safety's*

TBT2: *protection of the environment*

TBT3: *quality requirements*

Further, the TBT notifications are classified upon the product sectors they cover. The databases cover 96 classifications on agricultural and manufacturing products at the HS2-digit level. The products under HS code of 01 to 24 belong to agricultural sectors and the products under HS codes of 24 to 95 belong to the industrial sectors.

5.4.2 Research question

This article aims to answer the following research question:

Differentiated by categories, how do the TBTs impacts the imports from China and the USA to the European Union member states?

Based on previous studies, TBTs affect agricultural products more than industrial products, and developing countries more than developed countries. Therefore, to find the most accurate answer to this question, four sub-questions are defined:

Differentiated by categories, how do the TBTs affect imports from China to the European Union in agricultural sectors?

Differentiated by categories, how do the TBTs affect imports from China to the European Union in industrial sectors?

Differentiated by categories, how do the TBTs affect imports from the US to the European Union in agricultural sectors?

Differentiated by categories, how do the TBTs affect imports from the US to the European Union in industrial sectors?

The model is estimated using the following gravity equation and includes Hecksher-Ohlin variables: market size, income similarity. We expect both of these indicators to be significant in our model like they were in previous similar studies (Warin et al. 2009). Following is the baseline model that is applied in this article:

$$Ex_{ij,t} = \propto_0 + \beta_1 accAgriTbt1_t + \beta_1 accAgriTbt2_t + \beta_3 accAgriTbt3_t + \beta_1 accInduTbt1_t + \beta_5 accInduTbt2_t + \beta_6 accInduTbt3_t + \beta_7 accTbt_t + \gamma_1 g_{ij,t} + \gamma_2 s_{ij,t} + \gamma_3 distance_{ij} + euLength_j \quad (1)$$

where,

$$Ex_{ij,t} = log(\frac{export_{ij,t}}{GDP_{j,t}}) \quad (2)$$

The Heckscher-Ohlin variables take the following forms:

$$g_{ij,t} = log(GDP_{it} + GDP_{jt}) \quad (3)$$

and,

$$s_{ij,t} = log\left[1 - (\frac{GDP_{it}}{GDP_{it}+GDP_{jt}})^2 - (\frac{GDP_{jt}}{GDP_{jt}+GDP_{it}})^2)\right] \quad (4)$$

In equation (1), $accAgriTbt1_t, accAgriTbt2_t, and\ accAgriTbt3_t$ represent total agricultural TBT notifications in three categories of year t. The variables $accInduTbt1_t, accInduTbt2_t$ and $accInduTbt3$ represent total industrial TBT notifications in three categories of year t. The variable $accTbt_t$represent total TBT notifications in year t.

The variable $g_{ij,t}$ is the market size of countries of exporting and importing in year t. The variable $s_{ij,t}$ represnets the market similarity of importing and exporting countries in year t.

We selected the three TBTs' categories that have the most issued notifications comparing other TBTs categories. The dependent variable is imports from China and the US, to the 27 country members of the EU covering the 2001-2015 period. The variable $\mathrm{Ex}_{\mathrm{ij,t}}$ is the logarithm of the country i's (China and the US) share of exports of importing GDP country j (the EU country members).[29] The independent variables include, the length of membership of the EU country members, market size, and market similarity, distance. One of the objectives of this study is also to compare the impacts of the TBTs in agricultural sectors with the impact of TBTs in industrial sectors. Therefore, we categorized TBTs and imports from China and the US based on two sectors: agricultural and industrial. The classification is made upon the HS-2Level classification.

5.5 Results

As the first step, we look at the heterogeneity across countries. In the following figures we highlighted the heterogeneity across the EU countries. The points in figures 5.3 to 5.6 refer to imports in each year between 2001-2015.

[29] Due to lack of the data for the period of interest, Czech Republic is dropped form the model.

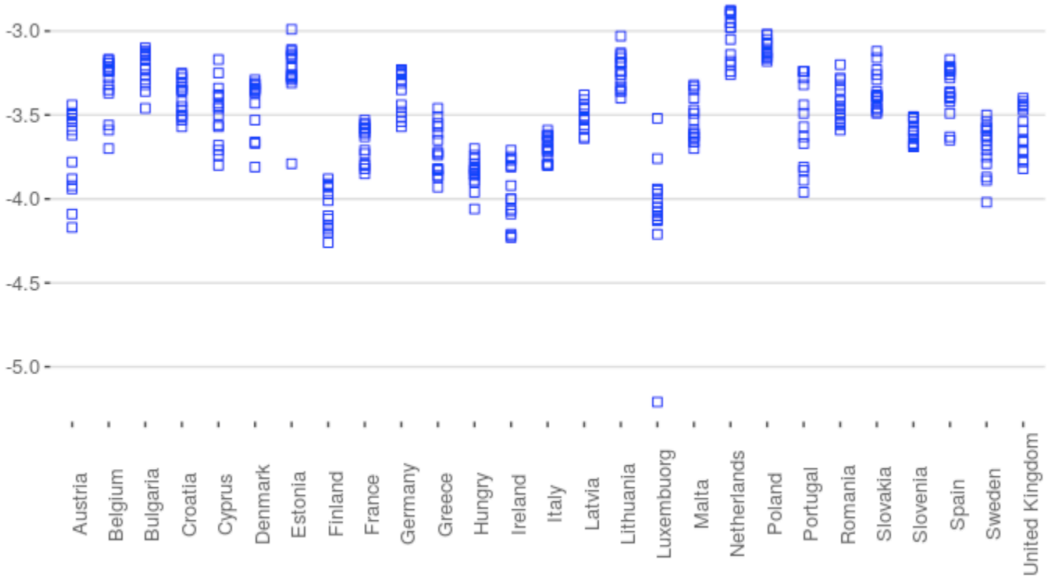

Figure 5.3: Heterogeneity across EU members- Imports From China in agricultural sector

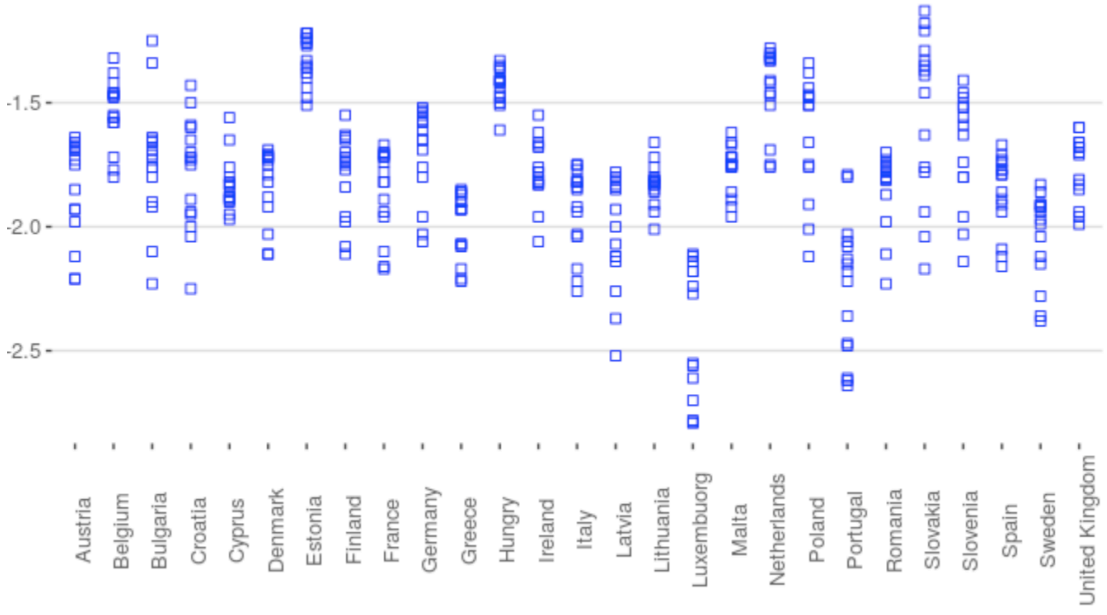

Figure 5.4: Heterogeneity across EU members- Imports From China in industrial sector

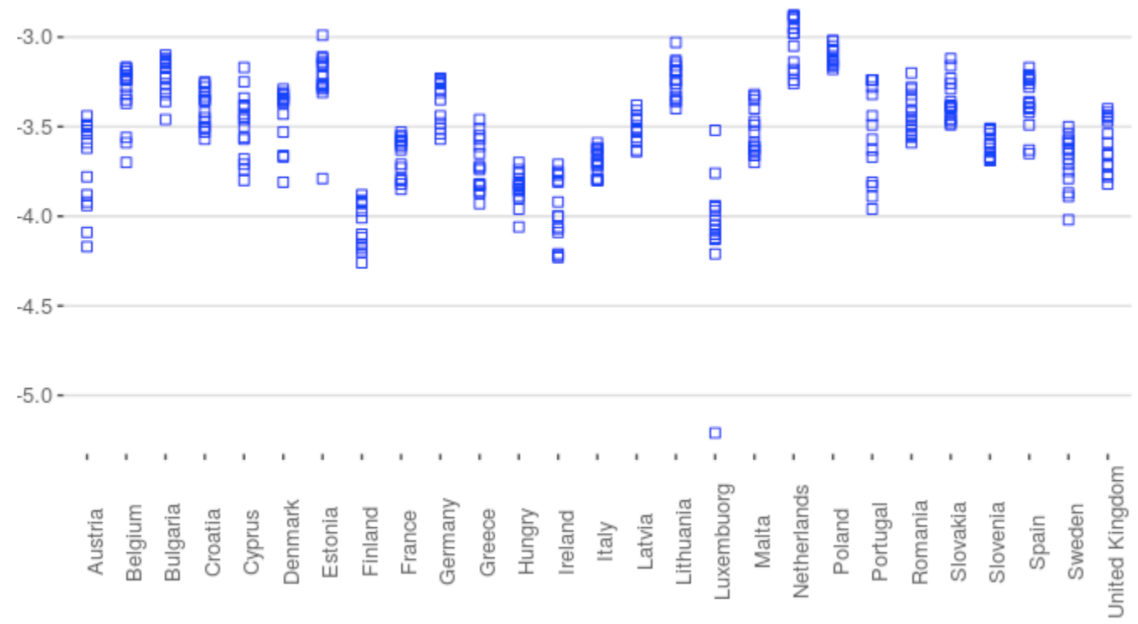

Figure 5.5: Heterogeneity across EU members- Imports From the USA in agricultural sector

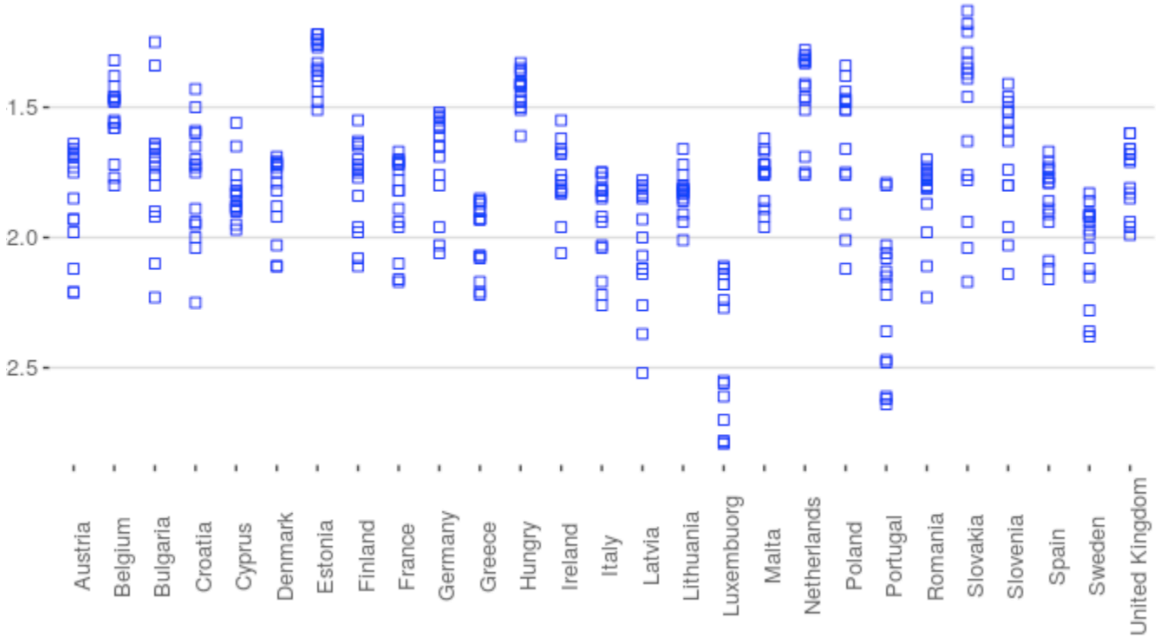

Figure 5.6: Heterogeneity across EU members- Imports From the USA in industrial sector

Due to the presence of heterogeneity, we prefer to apply a panel data analysis versus an OLS model. To be sure about using panel data analysis and adding the appropriate fixed effects to the gravity equation, we need to verify several assumptions. The assumptions are as follows:

1) contemporaneous correlation (cross-sectional dependence), by using Breusch-Pagan and Pesaran tests.
2) serial correlation using Breusch-Godfrey / Wooldridge test
3) unit root (non-stationary) using tests Dicky-Fuller test
4) heteroscedasticity using Breusch-Pagan test
5) adding time fixed effects using Hausman test and Breusch-Pagan Lagrange multiplier (LM) test

We checked the above assumptions and tests for the four sets of data. The results, however, proved the presence of serial correlation, cross-sectional dependency, along with stationary and heteroscedastic datasets. Also the results of the Breusch-Pagan Lagrange multiplier (LM) test confirmed the need to add time fixed effects to the models. We used the Driscoll and Kraay method as the first estimator for the panel data analysis. Further, we apply the PPLM method.

Since prior to WTO TBT Agreement (2008), there was no classification for TBTs. Hence there is no result for TBT1, TBT2, and TBT3 for the period of 2001-2007. However, we compare the whole period (2000-2015) to the sub period of 2008-2015.

Table 5.1 shows the results for imports from China to the EU, in agricultural sectors. As the table reads, TBT1, protection of human and health or safety, and TBT2, protection of the environment, has negative impacts on imports to China over the period from 2001 to 2015. However, TBT1 changed to have positive impacts in the period of 2008 to 2015. The impacts of TBT3, quality requirements, remain positive in both periods. The total TBT notifications have positive impacts on imports from China however, the impacts changed to negative in the period of after TBT Agreement. The impacts of the TBT notifications in agricultural sectors are statistically significant and positive prior to the WTO TBT Agreement, but the results for the period after the TBT agreement does not show the same trend. The results also show a negative coefficient of market size and market similarity. The length of the EU membership has significant positive impacts on imports from China to the EU in agricultural sectors.

Table 5.1: Regression result (Driscoll and Kraay)- Imports from China in agriculture sector

Regression Result

Dependent variables:

Imports from China to the EU- Agricultural sector

	2001-2015	2001-2007	2008-2015
Lag(depVar, 1)	0.447***	0.311***	0.252***
	(0.281, 0.612)	(0.133, 0.489)	(0.078, 0.427)
g	-0485***	-0.611***	-0.495***
	(-0.622, -0.348)	(-1.120, -0.101)	(-0.739, -0.250)
s	-0.268***	-0.278***	-0.243***
	(-0.338, -0.197)	(-0.485, -0.071)	(-0.338, -0.147)
euLength	0.020***	0.030**	0.049***
	(0.011, 0.030)	(0.006, 0.053)	(0.014, 0.084)
accAgriTBT1	-0.018***		0.003***
	(-0.023, -0.013)		(0.002, 0.004)
accAgriTBT2	-0.012***		-0.013***
	(-0.015, -0.010)		(-0.016, -0.011)
accAgriTBT3	0.006***		0.0003
	(0.005, 0.007)		(-0.0004, 0.001)
agriTBTNotifications	0.004***	0.192***	-0.0001
	(0.003, 0.004)	(0.136, 0.247)	(-0.0002, 0.00003)
accTBT	0.0004***	-0.002***	-0.0001***
	(0.0003, 0.001)	(-0.003, -0.001)	(-0.0001, -0.0001)
Time fixed effect	YES	YES	YES

Note: *p<0.1; **p<0.05; ***p<0.01

Driscoll and kraay

With serial correlations, contemporaneous correlation and heteroskedasticity

All the commands and algorithms are coded in R 3.4 using the plm package

Table 5.2: Regression result (Driscoll and Kraay)- Imports from China in industrial sector

Regression Result

Dependent variables:

Imports from China to the EU- Industrial sector

	2001-2015	2001-2007	2008-2015
Lag(depVar, 1)	0.687***	0.640***	0.059
	(0.538, 0.835)	(0.485, 0.795)	(-0.022, 0.140)
g	0.005	0.098	-0.659***
	(-0.124, 0.134)	(-0.159, 0.354)	(-0.965, -0.354)
s	0.001	-0.025	-0.309***
	(-0.068, 0.070)	(-0.205, 0.155)	(-0.420, -0.197)
euLength	0.026***	0.015	0.052***
	(0.017, 0.036)	(-0.007, 0.037)	(0.013, 0.091)
accIndTBT1	0.0004***		-0.003***
	(0.0003, 0.0005)		(-0.003, -0.001)
accIndTBT2	-0.001***		0.001***
	(-0.001, -0.001)		(0.0003, 0.001)
accIndTBT3	-0.001***		0.001***
	(-0.001, -0.0005)		(0.001, 0.002)
indTBTNotifications	-0.0001***	-0.0001	-0.0001***
	(-0.0001, -0.0001)	(-0.001, 0.0004)	(-0.0001, 0.00004)
accTBT	-0.00003	-0.00002	0.001***
	(-0.0001, 0.00001)	(-0.0001, 0.0001)	(0.001, 0.001)
Time fixed effect	YES	YES	YES

Note: *p<0.1; **p<0.05; ***p<0.01

Driscoll and kraay

With serial correlations, contemporaneous correlation and heteroscedasticity

All the commands and algorithms are coded in R 3.4 using the plm package

Table 5.2 shows the results of imports from China to the EU countries, in industrial sectors. As the table reads, TBT2, protection of the environment, and TBT3, quality requirement have significant negative impacts on imports to China in industrial sectors, over the period of 2001 to 2015. However, the coefficients changed to be significantly positive in the period of 2008 to 2015. The impacts of TBT1, protection of human and health or safety, are positive over the period of 2001 to 2015, but the impacts are significantly negative after the TBT Agreement. The total TBT notifications have positive (not significant) impacts on imports from China in industrial sectors before the TBT Agreement, however, the impacts changed to significantly positive (not large) after the TBT Agreement. The impacts of the TBT notifications in industrial sectors are significantly negative (not large) before and after the TBT Agreement. The length of the EU membership has significant positive impacts on imports from China to EU in agricultural sectors.

Table 5.3: Regression result (Driscoll and Kraay)- Exports from the USA in agricultural sector

Regression Result

Dependent variables:

Imports from the US to the EU- Agricultural sector

	2001-2015	2001-2007	2008-2015
Lag(depVar, 1)	0.470***	0.3540***	0.057
	(0.418, 0.722)	(0.425, 0.655)	(-0.162, 0.276)
g	-0.319**	-0.108***	-0.815**
	(-0.571, -0.067)	(-0.542, 0.326)	(-1.568, -0.062)
s	-0.124**	-0.140	-0.042
	(-0.223, -0.024)	(-0.551, 0.272)	(-0.315, 0.231)
euLength	0.022***	0.041**	0.051***
	(0.008, 0.036)	(0.018, 0.064)	(0.016, 0.086)
accAgriTBT1	-0.006		0.004***
	(-0.014, 0.001)		(0.001, 0.007)
accAgriTBT2	-0.018***		-0.012***
	(-0.022, -0.014)		(-0.016, -0.008)
accAgriTBT3	-0.003***		-0.006***
	(-0.004, -0.001)		(-0.009, -0.003)
agriTBTNotifications	0.001*	0.168***	0.0001
	(-0.00002, 0.003)	(0.051, 0.284)	(-0.0001, 0.0003)
accTBT	0.0002*	-0.002***	-0.00002*
	(-0.00001, 0.0004)	(-0.004, -0.001)	(-0.0001, -0.0000)
Time fixed effect	YES	YES	YES

Note: *p<0.1; **p<0.05; ***p<0.01

Driscoll and kraay

With serial correlations, contemporaneous correlation and heteroskedasticity

All the commands and algorithms are coded in R 3.4 using the plm package

Table 5.3 shows the result for imports from the USA to the EU countries, in agricultural sectors. As the table reads, TBT1, protection of human and health or safety's, TBT2, protection of the environment, and TBT3, quality requirement have negative impacts on imports to the USA in agricultural sector, over the period of 2001 to 2015. However, the coefficient of TBT1 changed to be significantly positive after the TBT Agreement. The total TBT notifications have significant negative impacts on imports from the USA in agricultural sectors before and after the TBT Agreement. The impacts of the TBT notifications in agricultural sectors are significantly positive before the TBT Agreement. The result also shows a negative coefficient of market size and market similarity. The length of the EU membership has significant positive impacts on imports from the USA to EU in agricultural sectors. The expected sign for market size (g) and market similarity (s) is positive however it may change because of different pattern of GDP growth between the US and the EU.

Table 5.4 shows the results of imports from the USA to the EU countries, in industrial sectors. As the table reads, TBT1, protection of human and health or safety, and TBT2, protection of the environment, have positive impacts on imports from the USA in industrial sector, over the period of 2001 to 2015. However, the coefficient of TBT2 changed to be significantly negative after the TBT Agreement. The impacts of TBT3, quality requirements, are significantly negative over the period of 2001 to 2015, as well as after the TBT Agreement. The total TBT notifications, have negative (not large) impacts on imports from China in industrial sectors before and after the TBT Agreement. The impacts of the TBT notifications in industrial sector are significantly negative over the period of 2001 to 2015 and the coefficient is larger after the TBT Agreement. Market size, market similarity and the length of the EU membership have significant positive impacts on imports from the USA to EU in industrial sectors.

Now as the second step, we run the PPLM estimator. As aforementioned, the PPLM is an appropriate alternative method in case of heteroscedasticity. The results are presented in the following tables.

Table 5.4: Regression result (Driscoll and Kraay)- Imports from the USA in industrial sector

Regression Result

Dependent variables:

Imports from the US to the EU- Industrial sector

	2001-2015	2001-2007	2008-2015
Lag(depVar, 1)	0.511***	0.259**	0.278**
	(0.421, 0.600)	(0.021, 0.496)	(0.069, 0.488)
g	0.337***	0.502***	1.457***
	(0.107, 0.566)	(0.170, 0.833)	(1.089, 1.825)
s	0.260***	0.324***	0.741***
	(0.126, 0.393)	(0.130, 0.518)	(0.653, 0.829)
euLength	0.026***	0.014	0.074***
	(0.015, 0.038)	(-0.004, 0.032)	(0.039, 0.109)
accIndTBT1	0.0002***		-0.003***
	(0.0001, 0.0003)		(0.002, 0.004)
accIndTBT2	-0.00004		-0.002***
	(-0.00002, 0.0002)		(-0.002, -0.001)
accIndTBT3	-0.0005***		-0.003***
	(-0.001, -0.0004)		(-0.003, -0.002)
indTBTNotifications	-0.0002***	0.001***	-0.0001***
	(-0.0002, -0.0002)	(0.001, 0.002)	(-0.0002, -0.00005)
accTBT	-0.0001***	-0.0002***	-0.002***
	(-0.0002, -0.00004)	(-0.0004, -0.0001)	(-0.002, -0.001)
Time fixed effect	YES	YES	YES

Note: *p<0.1; **p<0.05; ***p<0.01

Driscoll and kraay

With serial correlations, contemporaneous correlation and heteroscedasticity

All the commands and algorithms are coded in R 3.4 using the plm package

Tables 5.5 and 5.6 compare the PPLM estimator of exports from China to the EU between agricultural and industrial sectors. In period of 2001 to 2015, notifications of TBT1, protection of human and health or safety are estimated to have negative impacts on imports from China in both sectors. Notifications of TBT2, protection of the environment, are estimated to have positive impacts in both sectors. The notifications of TBT3, quality requirements, are estimated to have negative impacts on exports from China in agricultural sector and positive impacts on exports from China in industrial imports. In total, notification of TBTs in agricultural sectors have positive impacts on exports from China to the EU, versus the notifications of TBTs in industrial sectors estimated to have negative impact (small coefficients) on exports from China to the EU members. The impacts of total notification of TBTs in both sectors are estimated to be negative in agricultural sectors and be positive in industrial sectors

Table 5.5: PPLM regression result- Imports from China in agricultural sectors

Regression Result

Dependent variables:

Imports from China to the EU- Agricultural sector

	2001-2015	2001-2007	2008-2015
g	1.145	0.260	1.345e+00
s	0.450	-0.180	6.248e-01
euLength	0.1230	0.0268	7.583e-02
distance	-0.004	-0.0007	3.030e-02
accAgriTBT1	-0.002		6.418e-0.2
accAgriTBT2	0.075		-1.702e-03
accAgriTBT3	-0.003		3.786e-05
agriTBTNotifications	0.0004	0.001	-1.051e-04
accTBT	-0.0001	0.0002	-1.723e+01
Time fixed effect	YES	YES	YES
Constant	13.289	14.1150125	-2.462e+02
Likelihood	-551912884	-191577695	-171069984

Note: Maximum Likelihood Estimation

Successive function values within tolerance limit

All the commands and algorithms are coded in R 3.4 using the plm package

Table 5.6: PPLM regression result- Imports from China in industrial sectors

Regression Result

Dependent variables:

Imports from China to the EU- Industrial sector

	2001-2015	2001-2007	2008-2015
g	1.205e+00	1.788	1.345e+00
s	7.789e-01	0.520	6.248e-01
euLength	7.123e-02	0.025	7.583e-02
distance	-1.175e-03	-0.005	3.030e-02
accInduTBT1	-5.441e-04		6.418e-0.2
accInduTBT2	2.887e-04		-1.702e-03
accInduTBT3	1.308e-03		3.786e-05
induTBTNotifications	-4.576e-04	-0.001	-1.051e-04
accTBT	4.513e-05	0.0001	-1.723e+01
Time fixed effect	YES	YES	YES
Constant	-2.875e+00	10.0159023	15.3286352
Likelihood	-36834531337	-5182477287	-12994760385

Note: Maximum Likelihood Estimation

Successive function values within tolerance limit

All the commands and algorithms are coded in R 3.4 using the plm package

Tables 5.7 and 5.8 compare the PPLM estimator of imports from the US to the EU between agricultural and industrial sectors. In period of 2001 to 2015, notifications of TBT1, protection of human and health or safety are estimated to have negative impacts on imports from the US in both sectors. Notifications of TBT2, protection of the environment, are estimated to have positive impacts in both sectors. The notifications of TBT3, quality requirements, are estimated to have negative impacts on imports from the US in agricultural sector and positive impacts on imports from the US in industrial imports. In total, notifications of TBTs in agricultural sectors have positive impacts (small coefficients) on imports from the US to the EU, versus the notifications of TBTs in industrial sector estimated to have negative impact (small coefficients) on imports from the US to the EU members. Similar, the impacts of total notifications of TBTs

in both sectors are estimated to be positive in agricultural sectors and be negative in industrial sectors.

The results of PPLM are different than the results of the Driscoll and Kraay method. However, the result of PPLM method is not significant versus the results of Driscoll and Kraay are significant.

Table 5.7: PPLM regression result- Imports from the USA in agricultural sectors

Regression Result

Dependent variables:

Imports from the USA to the EU- Agricultural sector

	2001-2015	2001-2007	2008-2015
g	2.449e+00	-0.448	7.723e-01
s	2.026e-01	-0.273	4.854e-01
euLength	1.987e-02	-0.0003	7.196e-02
distance	-1.926e-03	0.0014	-2.759e-03
accAgriTBT1	-1.155e-03		-1.342e-03
accAgriTBT2	7.192e-02		7.345e-02
accAgriTBT3	-8.856e-03		-6.362e-03
agriTBTNotifications	5.175e-04	0.0008	5.146e-04
accTBT	5.524e-07	0.0001	5.580e-06
Time fixed effect	YES	YES	YES
Constant	2.567e+01	20.0722022	1.627e+01
Likelihood	-2676917623	-670784551	-779033477

Note: Maximum Likelihood Estimation

Successive function values within tolerance limit

All the commands and algorithms are coded in R 3.4 using the plm package

Table 5.8: PPLM regression result- Imports from the USA in agricultural sectors

Regression Result

Dependent variables:

Imports from the USA to the EU- Industrial sector

	2001-2015	2001-2007	2008-2015
g	8.878e-01	-0304	0.607
s	3.742e-01	-0.431	0.353
euLength	-1.697e-02	-0.0805	0.139
distance	-2.527e-03	0.0012	-0.0024
accInduTBT1	-4.668e-04		-0.001
accInduTBT2	4.446e-04		0.0008
accInduTBT3	1.520e-03		0.002
induTBTNotifications	-1.694e-04	-0.0004	-0.0002
accTBT	-8.376e-06	0.0003	0.00013
Time fixed effect	YES	YES	YES
Constant	1.648e+01	21.1400703	20.9355500
Likelihood	-24176118001	-6057094010	-10257150558

Note: Maximum Likelihood Estimation

Successive function values within tolerance limit

All the commands and algorithms are coded in R 3.4 using the plm package

5.6 Robustness check

In order to verify the robustness of our models, we apply the alternative TSCS-based techniques. The Generalized Least Squares (GLS) technique, first described by Parks (1967), is the method that is traditionally used in dealing with TSCS data. The flaw of the GLS technique for TSCS is that it produces inaccurate standard errors and violates the Gauss-Markov assumption (Beck and Katz 1995). The Gauss-Markov assumption is that $\epsilon_{i,t}$ is independent and distributed identically. In our data, each country may have its own error variance (heteroscedasticity). Panel heteroscedasticity is one type of inter-unit heterogeneity. Appendix

D shows the heterogeneity across countries for both China and the US and both sectors. The solution to heterogeneity is to model it by adding the fixed and random effects. Therefore, this article applies estimation techniques based on a series of mixed-effects models with temporal pseudo-replication, also known as growth models, due to the time-series cross-section (TSCS) dimension of both databases. TSCS data consist of repeated observations (often annual) within the series of fixed units (usually states or countries), where the series are important themselves (Beck 2001). Therefore, the following statistical methods are used:

1) GLS: a baseline method predicting trade inflows;
2) Mixed-effects: a method with random intercepts across countries;
3) Time RI: a method with time as a predictor of trade inflows and random intercepts across countries;
4) Time RS: a method with time as a predictor, a random effect of time over countries and random intercepts;
5) Autoregressive: a method with time as a predictor, random effects of time across countries, a random effect of intercepts across countries, and a first-order autoregressive covariance structure.

Equation 1 is applied for both databases of China and the US. Following, the results of agricultural and industrial sectors are presented and compared with each other. Further, a comparison of TBTs' trade impacts for China and the US is presented.

5.6.1 China

Table 5.9 shows the results of imports from China to the EU members in agricultural sectors. As table 5.9 reads that notifications of category TBT1 have negative impacts however, the impacts are not large and significant (except in the random intercepts model which the coefficient is small but significant, -0.001). The other two TBTs' categories (TBT2 and TBT3) have positive impacts, but not large and significant. The RS method shows a negative (not significant) impact of total TBTs on the China exports to the EU. This is similar to the previous finding on trade impacts of TBTs on China exports (Zhang and Lu 2002; Hu et al. 2017).

Table 5.10 shows the regression results of imports from China to the EU country members in industrial sectors. Similar to agricultural sectors, TBT1 create negative impacts, which are significant but not large. The result form the mixed effects methods, also show negative coefficients for category TBT2 (not similar to agricultural sectors). The coefficients of notifications from category TBT3, however, are significantly positive (not large) which is similar to agricultural sector.

The results of control variables are also considerable for both agricultural and industrial sectors. As table 5.9 reads the RS method shows a significant positive impacts of length of the EU membership on imports from China to the EU, but negative significant impacts of market size (g) and market similarity (s).

Table 5.9: Regression result- Imports of China to the EU in agricultural sector (2001-2015)

	Dependent variable: Imports of China to the EU agricultural sector 2001-2015 (log)				
	GLS	RI	Time RI	Time RS	Auto Regression
g	0.188**	-0.031	-0.135*	-0.138*	0.166
	(0.008, 0.367)	(-0.147, 0.084)	(-0.281, 0.011)	(-0.283, 0.007)	(-0.034, 0.367)
s	0.006	-0.115***	-0.141***	-0.145***	-0.104***
	(-0.025, 0.036)	(-0.189, -0.041)	(-0.219, 0.064)	(-0.223, -0.067)	(-0.181, -0.027)
euLemgth	-0.004***	0.010***	0.011***	0.011***	0.0003
	(-0.006, -0.002)	(0.003, 0.016)	(0.004, 0.018)	(0.004, 0.018)	(-0.004, 0.010)
accAgriTBT1	-0.001	-0.001*	-0.0003	-0.0003	-0.001
	(-0.003, 0.002)	(-0.002, 0.0001)	(-0.002, 0.001)	(-0.002, 0.001)	(-0.002, 0.001)
accAgriTBT2	-0.0005	0.001	0.0002	0.0002	-0.0003
	(-0.004, 0.003)	(-0.001, 0.002)	(-0.002, 0.002)	(-0.002, 0.002)	(-0.002, 0.001)
accAgriTBT3	0.142**	-0.018	0.002	0.002	0.004
	(0.011, 0.237)	(-0.179, 0.143)	(-0.162, 0.167)	(-0.162, 0.166)	(-0.155, 0.163)
accTBT	-0.0001	0.00002	-0.00004	-0.00004	-0.0000
	(-0.00005, 0.00003)	(-0.00001, 0.00004)	(-0.0001, 0.00002)	(-0.0001, 0.00002)	(-0.0001, 0.00005)
year			0.062*	0.062**	-0.011
			(0.007, 0.116)	(0.008, 0.117)	(-0.071, 0.049)
Constant	-8.842***	-3.191*	-123.469**	-124.909**	12.999
	(-13.880, -3.804)	(-6.378, -0.005)	(-230.467, -16.471)	(-231.713, -18.105)	(-103.569, 129.568)
Time Fixed Effects	YES	YES	YES	YES	YES
Observations	405	405	405	405	405
Log Likelihood	-73.752	178.079	180.498	180.619	259.340
Akaike Inf. Crit.	165.505	-336.158	-338.996	-335.238	-490.679
Bayesian Inf. Crit.	201.540	-296.119	-294.954	-283.187	-434.625

Note:

*p<0.1; **p<0.05; ***p<0.01

Time series estimations based on a time-series cross-section analysis,
With no serial correlation, no contemporaneous correlation and no heteroscedasticity
All the commands and algorithms are coded in R 3.3.2 using the plm package

Table 5.10: Regression result- Importss of China to the EU in industrial sector (2001-2015)

	Dependent variable: Imports of China to the EU Industrial sector 2001-2015 (log)				
	GLS	RI	Time RI	Time RS	Auto Regression
g	0.108	-0.116	-0.110	-0.110	-0.022
	(-0.077, 0.293)	(-0.264, 0.033)	(-0.255, 0.035)	(-0.255, 0.035)	(-0.220, 0.175)
s	0.023*	0.010	-0.007	-0.007	-0.114***
	(-0.004, 0.050)	(-0.050, 0.071)	(-0.067, 0.054)	(-0.067, 0.054)	(-0.183, -0.045)
euLemgth	-0.004***	0.0005	0.001	0.001	0.004
	(-0.006, -0.002)	(-0.005, 0.006)	(-0.004, 0.007)	(-0.004, 0.007)	(-0.003, 0.010)
accIndTBT1	-0.0005***	-0.001***	-0.0001	-0.0001	-0.00003
	(-0.001, 0.0002)	(-0.001, -0.0003)	(-0.0004, 0.001)	(-0.0004, 0.0001)	(-0.0002, 0.0001)
accIndTBT2	0.0002	0.0001	-0.0002	-0.00002	-0.00003
	(-0.001, 0.001)	(-0.0003, 0.001)	(-0.0004, 0.0004)	(-0.0004, 0.0004)	(-0.0003, 0.0003)
accIndTBT3	0.002**	0.002***	0.001*	0.001*	0.0001
	(0.000, 0.007)	(0.001, 0.002)	(-0.0001, 0.001)	(-0.0001, 0.001)	(-0.0001, 0.001)
accTBT	0.0001***	0.0001***	-0.0001**	-0.0001**	-0.0001***
	(0.00002, 0.00001)	(0.0001, 0.0001)	(-0.0002, -0.00001)	(-0.0002, -0.00001)	(-0.0002, 0.0001)
year			0.157***	0.157***	0.172***
			(0.094, 0.220)	(0.094, 0.220)	(0.116, 0.228)
Constant	-5.041***	1.131	-312.575**	-312.571**	-345.190***
	(-10.240, 0.157)	(-2.972, 5.233)	(-438.520, -186.631)	(-438.522, -186.621)	(-457.657, -232.723)
Time Fixed Effects	YES	YES	YES	YES	YES
Observations	405	405	405	405	405
Log Likelihood	-15.114	240.578	252.383	252.382	380.737
Akaike Inf. Crit.	48.228	-461.156	-482.766	-478.765	-733.475
Bayesian Inf. Crit.	84.263	-421.118	-438.723	-426.714	-677.420

Note:

*p<0.1; **p<0.05; ***p<0.01

Time series estimations based on a time-series cross-section analysis,
With no serial correlation, no contemporaneous correlation and no heteroscedasticity
All the commands and algorithms are coded in R 3.3.2 using the plm package

5.6.2 United States of America

Table 5.11 shows the results of imports from the US to the EU country members in agricultural sectors. As table 5.11 reads s that notifications of category TBT1 have significant positive impacts (from auto regressive method) however, the impacts are not large (0.002). This impact is not similar to trade impacts of notification from category TBT1 in China. The notifications from category TBT3 have significant negative impacts on imports from the US to the EU countries. The trade impacts of total TBTs on imports from the US are not significant therefore we can conclude that TBTs create any obstacles on imports in agricultural sectors, from the US to the the EU countries.

Table 5.12 shows the regression results of imports from the US to the EU country members in industrial sectors.[30] Similar to China (in industrial sector) notifications from category TBT1 create negative impacts, which are significant but not large. The results from the mixed effects methods for notifications from categories TBT2 and TBT3, however, show significant positive coefficients (not similar to agricultural sectors). Total TBT notifications also create not large but significant negative trade impacts on imports from US to the EU in industrial sector (similar to the China exports in industrial sectors).

The results of control variables are also considerable for both agricultural and industrial sectors. As table 5.12 reads the mixed effects method show a large significant positive impacts of length of the EU membership (euLength), market size (g), and market similarity (s) on imports from the US to the EU in industrial sector. However, the results for the agricultural sector are slightly different. The coefficients of market size and market similarity are significantly negative on imports from the US.

[30] The auto regressive method is dropped because of error of heterogeneity.

Table 5.11: Regression result- Imports of the US to the EU in agricultural sector (2001-2015)

	Dependent variable: Imports of the US to the EU agricultural sector 2001-2015 (log)				
	GLS	RI	Time RI	Time RS	Auto Regression
g	-0.313***	-0.369***	-0.415***	-0.415***	-0.122
	(-0.453, -0.173)	(-0.484, -0.253)	(-0.583, -0.247)	(-0.583, -0.247)	(-0.354, 0.111)
s	-0.095***	-0.111***	-0.111***	-0.111***	-0.142***
	(-0.120, 0.070)	(-0.172, -0.051)	(-0.171, 0.050)	(-0.171, -0.050)	(-0.207, -0.076)
euLemgth	-0.008***	0.011***	0.011***	0.011***	0.011***
	(0.006, 0.010)	(0.006, 0.016)	(0.006, 0.016)	(0.006, 0.016)	(0.005, 0.016)
accAgriTBT1	0.001	0.001	0.001	0.001	0.002***
	(-0.001, 0.004)	(-0.0004, 0.003)	(-0.0004, 0.003)	(-0.0004, 0.003)	(0.0004, 0.003)
accAgriTBT2	-0.0005	0.014	0.007	0.007	-0.036
	(-0.119, 0.118)	(-0.066, 0.095)	(-0.076, 0.090)	(-0.076, 0.090)	(-0.081, 0.009)
accAgriTBT3	-0.003	-0.003**	-0.003**	-0.003**	-0.002*
	(-0.007, 0.001)	(-0.006, -0.001)	(-0.006, -0.0002)	(-0.006, -0.0002)	(-0.004, 0.0002)
accTBT	0.0001	0.0002*	0.0001	0.0001	-0.0001
	(-0.00002, 0.00003)	(-0.00003, 0.0004)	(-0.0001, 0.0003)	(-0.0001, 0.0003)	(-0.0002, 0.0001)
year			0.011	0.011	-0.011
			(-0.017, 0.039)	(-0.017, 0.039)	(-0.050, 0.028)
Constant	4.651**	6.253***	-13.735	-13.735	21.651
	(0.802, 8.449)	(3.030, 9.477)	(-66.365, 38.896)	(-66.366, 38.895)	(-51.190, 94.492)
Time Fixed Effects	YES	YES	YES	YES	YES
Observations	405	405	405	405	405
Log Likelihood	-5.675	132.840	133.125	133.124	234.427
Akaike Inf. Crit.	31.350	-243.681	-242.251	-238.248	-438.854
Bayesian Inf. Crit.	71.389	-199.638	-194.204	-182.194	-378.796

Note:

*p<0.1; **p<0.05; ***p<0.01

Time series estimations based on a time-series cross-section analysis,
With no serial correlation, no contemporaneous correlation and no heteroscedasticity
All the commands and algorithms are coded in R 3.3.2 using the plm package

Table 5.12: Regression result- Imports of the US to the EU in industrial sector (2001-2015)

	Dependent variable: Imports of the US to the EU industrial sector 2001-2015 (log)			
	GLS	RI	Time RI	Time RS
g	0.200***	-0.025	0.421***	0.421***
	(0.056, 0.344)	(-0.103, 0.054)	(0.283, 0.559)	(0.284, 0.559)
s	0.450***	0.357***	0.412***	0.412***
	(0.442, 0.479)	(0.289, 0.425)	(0.348, 0.476)	(0.348, 0.476)
euLength	0.010***	0.012***	0.013***	0.013***
	(0.008, 0.012)	(0.006, 0.018)	(0.007, 0.019)	(0.007, 0.019)
accIndTBT1	-0.0002	-0.0002*	-0.0003***	-0.0003***
	(-0.001, 0.0002)	(-0.0003, 0.00001)	(-0.0005, -0.001)	(-0.0005,- 0.0001)
accIndTBT2	0.001	0.0004*	0.001***	0.001***
	(-0.0005, 0.001)	(-0.0000, 0.001)	(0.0001, 0.001)	(0.0001, 0.001)
accIndTBT3	0.0001	0.0002	0.001**	0.001**
	(-0.002, 0.002)	(-0.001, 0.001)	(0.00002, 0.002)	(0.00002, 0.002)
accTBT	-0.001***	-0.0003***	-0.0002***	-0.0002**
	(-0.001, -0.0003)	(-0.0004, -0.0002)	(-0.0003, -0.0001)	(-0.0003, -0.0001)
year			-0.088***	-0.088***
			(-0.111,- 0.065)	(-0.111,- 0.065)
Constant	-7.363***	-1.811	162.710***	162.722***
	(-11.354, 3.372)	(-4.243, 0.622)	(119.098, 206.321)	(119.304, 206.140)
Time Fixed Effects	YES	YES	YES	YES
Observations	405	405	405	405
Log Likelihood	-71.190	230.618	256.855	257.208
Akaike Inf. Crit.	162.380	-439.236	-489.711	-486.416
Bayesian Inf. Crit.	202.418	-395.193	-441.664	-430.361

Note:
*p<0.1; **p<0.05; ***p<0.01

Time series estimations based on a time-series cross-section analysis,
With no serial correlation, no contemporaneous correlation and no heteroscedasticity
All the commands and algorithms are coded in R 3.3.2 using the plm package

The result of imports from China in agricultural sectors to the EU verify the results of Driscoll and Kraay model. Also the result of imports from China in industrial sectors is similar to Driscoll and Kraay except for TBT1. The coefficient of industrial TBT1 in Driscoll and Kraay method is 0.0004 versus in RI method is -0.001. Although the difference between coefficients is not large (0.0014) still is concerning.

The result of imports from the US in industrial sectors is similar to Driscoll and Kraay except for TBT1 and TBT3. The coefficient of industrial TBT1 in Driscoll and Kraay method is 0.0002 versus in RI method is -0.0003. Although the difference between coefficients is not large (0.0005) still we suggest further studies. Similarly, the coefficient of industrial TBT3 in Driscoll and Kraay method is -0.0005 versus in RI method is 0.001 (the difference is 0.0015). Overall, the result of robustness check is satisfactory.

5.7 Conclusion

Compared to other categories of non-tariff barriers, TBTs are relatively new but very important (Bao and Qiu, 2012). The TBTs are considered as the most challenging barriers to be measured (Deardorff & Stern, 1997). The trade impacts of TBT, however, vary across countries and sectors. Moreover, certain products are more subject to technical regulations than others (Messerlin and Zarrouk, 2000). For instance, a country as peanut producer gets more difficulties applying the technical regulations on health comparing a country as wood producer. All these factors, interests the researchers to study technical regulations in many perspectives such as global, micro-level, consumer willingness to pay, trade agreement, trade of countries with different level of development, and trade of different sectors.

This article studies trade impacts of TBTs differentiated by categories on agricultural and industrial sectors. For this matter, two case studies are adopted: the imports from China and the US to the European Union country members. The finding confirmed that trade impacts of TBTs TBTs with dissimilar primary objective , is not the same as well as NTBs in different categories. Our The protection of human and health or safety's TBTs have negative impacts on imports in agricultural sectors from China, therefore issuing notification in this category, is expected to create technical barriers to trade. The TBT notifications in category of the

protection of the environment have positive impacts on imports from both China and the US in industrial sectors.

To our knowledge, however, there is no previous study available, that make us able to compare the findings of this article with it. Therefore, we suggest more studies, which compare the trade impacts of TBTs, regarding their categories.

CHAPTER 6 ARTICLE 3: TECHNICAL BARRIERS TO TRADE: A CANADIAN PERSPECTIVE ON ECOLABELLING

Abstract[31]

Ecolabelling is a market-based instrument and an important element of international environmental policies. In our day and age, there is a wide range of ecolabels, which may complicate the decision-making process when looking for the best outcome for consumers and producers. The International Organization for Standardization (ISO) and Global Ecolabelling Network (GEN) suggest a solution to align the various ecolabelling programs. For instance, ISO launched the ISO 14001 framework, which includes the requirements for Environmental Management Systems (EMSs). The GEN harmonizes international ecolabelling schemes and improves exchanges of information among its country members. This article addresses how unaligned and aligned regulations impact international trade. Consequently, a database including the ISO 14001 certifications of all countries and containing the exports from 153 countries to Canada from 2001 to 2015 as a dependent variable was created. The remaining variables will serve as independent variables, including gravity variables such as market size, market similarity, distance, and some other core variables such as GEN membership of the exporting country, WTO membership, binding in Free Trade Agreements (FTA) and Mutual Recognition Agreements (MRA) with Canada. Findings show that holding ISO 14001 certifications has a positive impact on exports to Canada; however, these impacts are not significant enough. Therefore, there is not strong evidence that ISO 14001 creates barriers to export to Canada. In addition, GEN membership significantly promotes exports to Canada, especially for countries binding in an FTA or MRA with Canada.

Keywords: Technical barriers to trade; Ecolabelling; Export; Canada;

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[31] Farnia, F., de Marcellis-Warin, N., Warin, T., (2018). Technical Barriers to Trade: A Canadian Perspective on Ecolabelling. *Global Economy Journal*. Volume 18, Issue 1, 20170090, ISSN (Online) 1553-5304, DOI: https://doi.org/10.1515/gej-2017-0090

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6.1 Introduction

Growing concerns on environmentally-friendly activities have created a large demand for environmental and safety measures. The main objectives of ecolabelling are "to raise consumer awareness about the environmental effects of products, to inform consumers about the environmental characteristics of a product and to promote the adoption of more environmentally sound production methods and technologies" (UNEP, 1997); however, evidence from the academic literature show that not all ecolabelling programs are consistent with these objectives.[32] The implementation of ecolabels and ecolabelling programs needs substantial investments such as training specialists, upgrading processes and purchasing equipment. Although ecolabelling is optional, it carries some characteristics of technical barriers to trade (TBT). There are some discussions among World Trade Organization (WTO) members that ecolabelling should fall into Trade-Related Environmental Measures (TREMs) and that the regulations in the WTO TBT Agreement should be applied to them. Also, welfare returns to investments in ecolabelling, and its success in terms of environmental protection depend on how firms would uptake ecolabelling certifications and consumer demands for ecolabelled products.

The growth of environmental activities over the past decades resulted in an increase in ecolabelling organizations (ELOs) engaged in environmental certifications and ecolabelling programs (Delmas et al., 2013). The ELOs are non-governmental institutions that establish a set of standards and rules of conduct to guide companies in the application of ecolabelling and the offering of ecolabelling programs. In fact, ecolabels should get certified by third parties, either a governmental or a non-governmental organization (Dauvergne & Lister, 2010); however, ELOs are not the only parties involved in conducting and operating ecolabelling standards. Civil society groups, industry associations, corporations and hybrid public-private organizations were also created to control ecolabelling standards (Ven, 2015). Hence, this

[32] Report of the Governing Council of the United Nations Environment Programme (UNEP), supplement No. 25, April 1997

diversity and lack of universal monitoring authority may create some major problems in terms of credibility and rigor.

Ecolabelling has obtained an effective ecological role in society. It contributes to environmentally-friendly activities and promotes sustainable development (Prieto-Sandoval et al., 2016; Gutiérrez et al., 2012); however, the higher price of ecolabelled products and the lack of trust in unknown ecolabels affect the demand for ecolabelling.

Environmental concerns rose among Canadian citizens over the past few decades. Consequently, on the one hand, policymakers started regulating business activities, and on the other hand, producers and service providers started offering environmentally-friendly products or services with environmentally friendly claims. These claims include: natural, recyclable, eco-friendly, low energy, recycled content, etc., which can be defined as "ecolabels". The Global Ecolabelling Network (GEN) defines ecolabelling as follows:

"Ecolabelling is a voluntary method of environmental performance certification and labelling that is practiced around the world. An ecolabel is a label that identifies the overall, proven environmental preference of a product or service within a specific product/service category."

In the Canadian context, ECOLOGO has been successfully implemented over the past two decades. ECOLOGO certifications fall in the same category as the International Organization of Standardization ISO type 1 ecolabels. Here, we analyze the impacts of another ecolabelling certification - ISO 14001 - as a technical barrier to trade on exports to Canada. The question is whether or not the dissimilarity between two ecolabelling programs, ECOLOGO and ISO, negatively affects exports to Canada. We also analyze the influence of ecolabelling networks such as the Global Ecolabelling Network (GEN) on the promotion of international trade. We choose imports from 153 countries to Canada over a period of 11 years, from 2003 to 2013. In terms of methodology, we design a time-series cross-section estimation, based on an augmented-gravity model (Anderson 1979; Helpman1987). Next section presents a background on Canadian ISO 14001 certifications and GEN. Section 3 presents the literature review on trade and ecolabelling, trade agreements and environment, and ecolabelling in a global perspective.

6.2 Background

6.2.1 ISO 14001 certification

Consumers of countries with a recognized ecolabelling program hardly trust another ecolabel. The variety of ecolabelling schemes and trust issues calls for the standardization and unification of practices. In September 1996, the International Organization for Standardization (ISO) launched ISO 14001 to harmonize the various ecolabelling programs (Jiang and Bansal, 2003). ISO 14001 is an international standard that issues some requirements for an Environmental Management System (EMS). ISO 14001 is very similar to ISO 9001 quality management standards. By the end of 2016, 1,644,357 ISO 14001 certifications had been issued for organizations in 201 countries.[33] Almost 52% of theses certifications belong to East Asian and Pacific areas versus less than 1% to Africa areas. ISO (2015) reports that organizations that are ISO 14001 certified have improved their overall environmental performances. In addition to environmental advantages, these standards also have economic advantages for organizations as listed below:

Cost savings: Avoiding unnecessary usage can lead to sizeable cost savings. In fact, ISO (2015) estimates savings of £1,000 per employee when trying to improve resource use.

Waste reduction: It is easy to cut waste once you know what you actually use. Not only does this avoid the use of landfills, but further costs are saved by reducing waste disposal.

Competitive advantage: In an increasingly difficult financial environment, the cachet of holding an internationally recognized standard sets you apart from the competition.

Win new business: ISO 14001 is a proven business winner, helping those bidding for local and central government projects to make the perfect bid. In the private sector, the standard is increasingly becoming a supply chain requirement.

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[33] Data available in www.iso.org

Retain existing customers: It is easier to retain existing clients than to find new ones. Showing your commitment toward reducing your environmental impact gives customers another reason to be loyal.

Legislative compliance: Failure to comply with environmental legislations could result in a PR disaster, fine or further prosecution. You can stay safe with ISO 14001.

Many countries accepted ISO 14001 as a universal environmental certificate (Hall et al., 2015); however, the response toward this ISO was not the same in North American countries and multinational firms with multiple subsidiaries (Jiang & Bansal, 2003). Jiang and Bansal (2003) conducted a survey on the application and performance of ISO 14001 in North America. They interviewed members of the Canadian pulp and paper industry who hold the ISO 14001 certification. They mentioned that the cost of obtaining an environmental certificate like ISO 14001 was between $24,000 and $128,000, and that to maintain ISO 14001 could cost between $5,000 and $10,000 (2003 cost estimates); however, if the firm already obtained the sophisticated EMS, the cost for an ISO 14001 certification would be much less than the others with no basis. They claimed that the comparative advantage of the certificate motivates most businesses, even those with financial problems (Bansal, 2002; Jiang & Bansal, 2003). Furthermore, factors like "market demand", "institutional pressure," and "management control" were other indicators influencing the request for ISO 14001 certification. This standard does not impose a specific technology but just mandates firms to have their EMS audited by the third-party. Hence, the production process should be clearly documented and conducted by experts to be appropriate for auditors for certification. Evidence shows that to achieve this, professional training and investment in documentation are required (Lim & Prakash, 2014). Therefore, businesses must spend extra money to meet certification requirements. According to the data on ISO's website, some businesses with a lower income cannot afford obtaining the ISO 14001 certification. Meanwhile, businesses in developing countries have been actively applying for the certificate in order to access the global market. Figure 6.1 shows the number of ISO 14001 certifications across different countries by end of 2016.

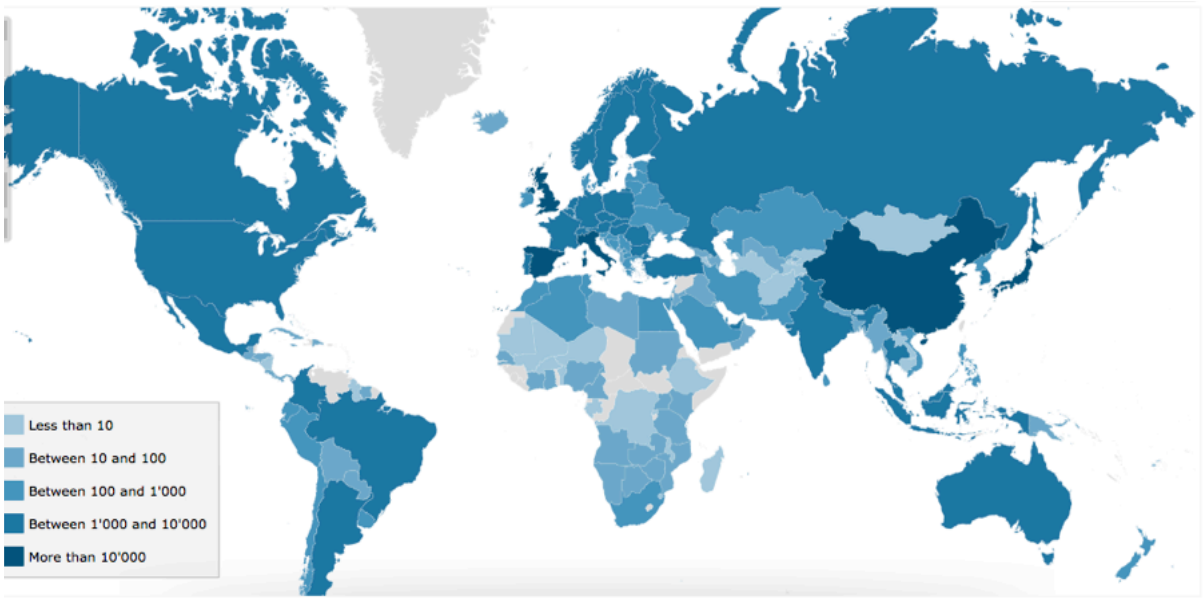

Figure 6.1: Number of ISO 14001 certifications per country by the end of 2016. Source: www.iso.org

ISO categorizes ecolabelling into three types of voluntary labels: Type I - lifecycle based, voluntary, multi-sectoral, environmental leadership, third-party labelling schemes Type II- self-declared claims (either lifecycle or single issue) Type III- environmental performance declarations or reports (non-selective). As table 6.1 reads, ISO 14024 contains Type I, ISO 14021 contains Type II, and the ISO 14025 contains Type III.

Table 6.1: ISO 14001 certification

Designation	**Title**
UNI EN ISO 14020	Environmental labels and declarations – General principles
UNI EN ISO 14024	Environmental labels and declarations – Type I environmental labelling –Principles and procedures
UNI EN ISO 14021	Environmental labels and declarations – Self-declared environmental claims – (Type II environmental labelling) "…sets out specific standard requisites and terms for the description; defines the assessment methodology to follow, sets out specific guidelines, confirming the manufacturer's declaration validity."
ISO/TR 14025	Environmental labels and declarations – Type III environmental declarations "…is a non-compulsory instrument that does not express the environmental performance of a product/service, with reference to pre-defined indicators."

Furthermore, most ecolabelling organizations follow Type 1 ecolabels as defined by ISO 14024.

6.2.2 Global Ecolabeling Network (GEN)

The Global Ecolabelling Network (GEN) is a non-profit association of third-party, environmental performance recognition, certification and labelling organizations founded in 1994 to facilitate the alignment of ecolabelling programs (Dauvergne and Lister, 2010). It is an association of representatives of ecolabelling organizations, which follow Type 1 ecolabels as defined by ISO 14024. The mission of GEN is to improve, develop and promote the ecolabelling of products and the credibility of ecolabelling programs worldwide. The GEN fosters cooperation, information exchange and harmonization among its members. The GEN does not develop criteria or certify products; instead, it supports members by developing environmental leadership standards in ecolabelling. Since the GEN is an association of labelling organizations, countries cannot become members of the GEN but are represented by the ecolabelling programs. The GEN currently has 27 members, the latest of which are listed in Table 6.2.

Table 6.2: List of GEN members as of July 2017

Country	Member
Australia	Good Environmental Choice Australia Ltd.
Brazil	Associacao Brasileira de Normas Tecnicas (ABNT)
China	China Environmental United Certification Center
China	China Quality Centre (CQC)
Chinese Taipei	Environment and Development Foundation
European Union	European Commission
Germany	German Federal Environmental Agency
Germany	TÜV Rheinland
Hong Kong	Green Council
India	Confederation of Indian Industry
Indonesia	Ministry of Environment
Israel	The Standards Institution of Israel (SII)
Japan	Japan Environment Association (JEA)
Kazakhstan	International Academy of Ecology of the Republic of Kazakhstan
Korea	Korea Eco-Products Institute
Malaysia	SIRIM QAS International Sdn Bhd
New Zealand	The New Zealand Ecolabelling Trust
Nordic	Nordic Ecolabelling Board: The Nordic Swan

Table 6.2: List of GEN members as of July 2017 (cont'd)

North America	ECOLOGO- UL environment
North America	Green Seal Inc.
Philippines	Philippine Center For Environmental Protection and Sustainable Development,
Russia	Eco-logical Union
Singapore	Singapore Environment Council
Sweden	Swedish Society for Nature Conservation (SSNC)
Sweden	TCO Development (TCO)
Thailand	Thailand Environment Institute
Ukraine	All Ukrainian NGO Living Planet

Source: www.iso.org

One of the activities of the GEN members is setting criteria for products and services with lower environmental burdens to provide a framework to exchange their information and cooperate among ecolabelling organizations. The GEN defines ecolabelling as the only program that is lifecycle based, voluntary, third-party, multi-sectoral and selective, according to the standards definition in ISO Type I, including 14024 (GEN Report, 2003). Moreover, the goal is to increase the supply and demand for environmental labelling products and services; however, despite all of these efforts, the literature shows no evidence of success for the GEN in achieving its goals. This paper includes GEN membership as a factor to examine whether it eliminates uncertainty or improves the reputation of ecolabels for its member countries, especially those that are less developed. In 2003, the GEN launched the Global Ecolabelling Network's Internationally Coordinated Ecolabelling System (GENICES) process, a framework for evaluating and auditing programs operated by GEN members to obtain mutual trust and recognition among all members. The GENICES ensures that the programs are in fact reputable operating Type I ecolabelling programs in compliance with ISO 14024. Applicants that successfully completed the GENICES sign a multilateral mutual recognition agreement (MMRA). GEN members conduct periodic reviews and update environmental criteria and categories by considering technological and marketplace development (RSMeans, 2011). The ECP of Canada submitted the GENICES application in March 2006; however, later in 2010, the ECP management was transferred to Underwriters Laboratories (UL) Environment who was already a GEN member, thus also making Canada represented in the GEN. The UL Environment is a global labelling company that reinforces the credibility of sustainable product claims through their certification, validation and testing services. The UL Environment assists

companies in their development and the execution and communication of their sustainability strategies and initiatives with advisory services. The UL ECOLOGO certifies products that meet multi-attribute, lifecycle-based sustainability standards. These standards set metrics for a wide variety of criteria for products in such categories as materials, energy, manufacturing and operations, health and environment, product performance and use, and product stewardship and innovation. No literature currently analyzes the effect of Canada's participation in the GEN as well as the effect of the transfer of ECOLOGO to the UL Environment.

6.3 Literature review

6.3.1 Trade and ecolabelling

To facilitate trade, countries frequently sign trade agreements, which eliminate tariffs and reduce non-tariff barriers to trade. Sustainable development issues, including environmental protection, are a prominent feature of many trade agreements. Increasing interest in environmental protection and conservation in sustainable development are strongly connected to the development of ecolabelling schemes. Harmonizing ecolabelling and certification, among other approaches, can achieve both goals of protecting the environment and promoting trade (Esty and Geradin, 1997). In addition, eliminating tariffs frees up resources for exporting countries that can then redirect them toward adopting ecolabelling if they expect them to be profitable. For example, Rugman and Verbeke (1998), who studied international environmental policies and the behavior of firms, report that an approved ecolabelled product in the market of the importing country creates a competitive edge for exporters especially when consumers are highly motivated to buy ecolabelled products. On the other hand, there are some discussions about the need for the Canadian government to "impose increasingly demanding sustainability requirements on producers and supply chain actors to protect Canadian resources, beyond current environmental programming" (MacRae, 2014). Therefore, as discussed, ecolabels are more likely to be TBT for exporters to Canada. Vranes (2011) advises against the implementation of mandatory ecolabelling and instead proposes voluntary ecolabelling, which is not discriminatory against trade; however, there is no evidence whether Canadian trade agreements eliminate the trade-impeding impacts of ecolabelling. This paper aims to explore the role of WTO, FTAs and MRAs on promoting exports to Canada. The following section

discusses the WTO as a trade organization that suggests special treatment for technical barriers to trade. The TBT Agreement has been launched by the WTO to unify technical regulations across the countries and eliminate regulations that are discriminatory toward trade.

i) WTO and ecolabelling

Following the dissatisfaction with the pre-Uruguay round treatment of trade and the environment, the WTO dedicated an official part of its agenda to trade and the environment. This resulted in the establishment of a WTO Committee on Trade and Environment (CTE). One of the CTE's missions is to examine trade measures for environmental purposes including those issued in multilateral agreements, ecolabelling and exports of domestically prohibited goods (Trebilcock and Howse, 2005); however, there has been some dispute about environmental labelling regulations among WTO members. The 2001 Doha Declaration demanded that the CTE include environmental labelling in its special concerns. Meanwhile, some members suggested including ecolabelling in the TBT Agreement. Current disciplines in the TBT Agreement apply to environmental labelling (ecolabelling) since this agreement identifies rights and obligations for both mandatory and voluntary labelling programs.

According to WTO reports, more than 10% of all notifications issued by the TBT and Sanitary and Phytosanitary Measures (SPS) were issued under the environmental protection objective. Most of these notifications touched on soil and water pollution abatement, energy conservation, planet and forestry conservation, consumer information, and protection of plants or territory from pests and diseases. Almost 20% of trade issues discussed by the TBT Committee were about measures aimed at environmental protection. These trade issues include the control of hazardous substances, chemicals, heavy metals, and vehicle and air pollution, the energy efficiency of equipment and electrical appliances (e.g., resource management, waste, reuse and recycling of vehicles, and electrical and electronic products), and other concerns about wood, fishery and seal products.

The TBT Agreement issued the Code of Good Practice for the Preparation, Adoption and Application of Standards for voluntary environmental labelling. This code must be used by any standardizing body within the territory of WTO members. In this matter, the WTO shares the information with the ISO/IEC Information Center. The Code requests that any standardization body in the member countries that accepted or withdrew from this Code report to the ISO/IEC

Information Center in Geneva; however, we must still determine "what special characteristics of a technical regulation distinguish it from other regulations and make it subject to more detailed obligations in the TBT Agreement" (Du, 2015).

Aiming at improving its members' knowledge about labelling requirements, the TBT committee organized the "Learning Event" on labelling, which covered both the implementation of the TBT Agreement and the impact of the requirements on market access. Given that some members are concerned that ecolabelling creates barriers for their exports, the TBT committee gave members the opportunity to share their perspectives on ecolabelling issues and the challenges of implementing ecolabels in their countries (Xu et al., 2012; Pérez-Ramírez et al., 2010).

Conformance of ecolabels with the international business rules set forth by the WTO is the focus of the research by Bartenstein and Lavallée (2003) who suggest that ecolabelling may become a "green protectionism" tool. That is, national governments could be pursuing the objective of creating or keeping the competitive advantage of their national products using ecolabelling in the name of environmental protection. This, in turn, could harm the reputation of ecolabels and undermine their true objective. Their analysis shows that ecolabels are not at serious risk of violating the relevant rules of international trade under the WTO agreements. Due to the absence of state constraints, they represent a legal and authorized commercial tool. That is, the ecolabel does not appear to be designed to distort competition through state intervention and does not constitute an unjustified restriction on trade but rather serves as a means to participate in the competition and benefit from it; however, the authors suggest that ecolabels of western countries can have a de facto discriminatory effect on developing countries. On the one hand, it is not clear whether their environmental protection priorities are the same as those of rich countries. On the other hand, developing countries do not have the same financial capacity and technological means.

The WTO has been offering technical assistance to facilitate the application of ecolabelling programs for lower-income countries. The Trade and Environment Committee pays special attention to the subject of environmental requirements and market access and its effects on developing countries. All WTO member governments acknowledge that sustainable development depends on improved market access for products from developing countries.

Environmental standards applied by some countries could result in unwarranted economic and social costs for other countries. The WTO is widespread enough to ensure that environmental regulations and standards do not create barriers to trade. Therefore, to remain consistent with WTO rules, its member governments take the capability of developing countries into account. Given the WTO's efforts in helping less-developed countries own their national ecolabels, some may question whether consumers in developed countries recognize these ecolabels or require well-known third-party certifications.

ii) Trade agreement and environment

Canada is currently involved in several trade agreements or negotiations such as the Trans-Pacific Partnership Agreement (TPPA), Canada-European Union Comprehensive Economic and Trade Agreement (CETA) and Canada-Korea Free Trade Agreement. Next, we review the recent related literature across different fields to describe each agreement in more details.

Trans-Pacific Partnership Agreement

The TPPA is one of the most important multilateral free trade and investment agreements in recent years (Zhang et al., 2017). The purpose of the TPPA is to promote economic growth, support the creation and retention of jobs, enhance innovation, productivity and competitiveness, raise living standards, reduce poverty in the signatory countries, promote transparency and good governance, and enhance labor and environmental protection. The final TPPA proposal was signed on February 4, 2016, between Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, Vietnam and the US; however, after the US withdrew on January 23, 2017, there were concerns whether the TPPA would be implemented or not. Japanese representatives declared that the TPPA was "meaningless", even though the Australian Prime Minister refused to accept that the TPPA was indeed dead. Despite the numerous goals of the TPPA, some argue that it has not fulfilled its objective of "environmental protection". In October 2016, the Foreign Affairs, Defense, and Trade Reference Committee of the US Senate published a critical analysis of Chapter 20 of the TPPA. The report states that "a close reading of the text of the TPPA reveals that the Environment Chapter fails to provide for sufficient protection in respect of the environment across the Pacific Rim." This Committee also argued that the environmental chapter of the TPPA lacked meaningful enforcement of environmental rules and standards.

Carrey and Holmes (2017) studied the impact of the TPPA on the Canadian automotive industry. They concluded that there is an increase in Canadian import penetration by vehicles manufactured in Japan due to the removal of tariffs by up to 6.1%. Hence, domestic vehicle production is negatively affected by an increase in imports resulting in a negative impact on automotive production and employment in Canada. Another study on the TPPA, by Ruckert et al. (2017), showed that obligations in regional trade agreements including the TPPA may conflict with several health-related sustainable development goals. The conflicts included unhealthy commodities, threats to equitable access to essential health services, medicine and vaccines, and reduced flexibility of government regulations. Karacaovali et al. (2017) analyzed international trade relations between the US, Canada, and Mexico with TPPA countries. They evaluated the gravity model using trade data collected between 1980 and 2015. Their results indicate that existing free-trade agreements among TPPA countries and between TPPA members and non-member countries affected trade in a positive way.

The impact of the TPPA on some non-member countries has also been studied. Zhang et al. (2017) conducted a comprehensive research on the relationship between China and TPPA countries from the perspective of the virtual water trade and agricultural products. They concluded that China imports many agricultural products from TPPA countries. Meanwhile, China exports a grey water footprint to TPPA countries, which is very important from an environmental perspective.

Canada-European Union Comprehensive Economic and Trade Agreement (CETA)

The CETA is the biggest Canadian trade agreement as of 2017. It is a progressive free trade agreement that covers virtually all sectors and aspects of Canada-EU trade in order to eliminate or reduce barriers (Warin, 2016). Here is a little bit of history about the CETA. In March 2004, Canada and EU leaders agreed to set up a framework for a new Canada-EU Trade and Investment Enhancement Agreement (TIEA). The CETA includes a trade and environment section, which proposes collaboration on technical regulations and standards through the TBT process. In the TIEA, ecolabelling is mentioned as an important issue in the chapter on sustainable development:

"Environment: transfers of environmentally friendly technologies, voluntary ecolabelling and certification, trade and environment technical assistance and capacity building." In addition,

Canada committed to recognize the benefits of ecolabelling and environmental performance goals and standards; however, the CETA references sustainable management and development (including ecolabelling) in relation to only two sectors: forestry and fisheries. Other industries such as mining, energy and transportation have not been included in the CETA.

It has been estimated that the CETA imposes additional costs in the magnitude of CAD 80mln-1.6bln to the Canadian public healthcare system (Lexchin and Gagnon, 2013); however, some studies support the CETA and see opportunities in this trade agreement. Warin (2015) states that, first, 98% of the tariffs for the EU will be eliminated, and within seven years, 99% of custom duties will have disappeared. Second, European certification can be obtained in Canada, meaning that Canadian exporters will not need to go to Europe to get European Conformity (Conformité Européenne or CE) certification. The effectiveness of including such sections in the CETA has not been studied from a Canadian perspective yet.

Canada-Korea Free Trade Agreement

The Canada-Korea Free Trade Agreement is the first FTA in the Asian region. Korea is the 11th largest economy worldwide and the 4th largest economy in Asia. The CKFTA came into force on January 2015. The Canadian-Korean agreement is limited in its scope and does not include Canadian purchasing, pricing and distribution practices. The CKFTA has applied much of the already existing WTO Agreement on Sanitary and Phytosanitary Measures (SPS Agreement) and the TBT Agreement; however, this agreement does not cover provincial, territorial or municipal procurement projects in Canada (Kukucha, 2016). Bachamnn (2017) suggested that the Canada-Korea FTA has small impacts on transportation gateways and is mostly concentrated in the Asia-Pacific Gateway, specifically in the Port of Vancouver, British Columbia. The Korea Ecolabel program launched by the Korea Eco-Products Institute (KEITI) in 1992 includes 150 standards and more than 10,000 awarded labels. The KEITI sets up the environmental standards, and through an evaluation system, offers eco-products and information on environmental trends to the public. The Korea Ecolabel program is a member of the GEN.

There are some discussions about the successful model of trade agreements between countries. Lake (2017) suggested a dynamic farsighted model of network development among asymmetric countries. He concluded that free trade agreements (FTAs) prevent global free

trade when two larger economies (countries) border a smaller economy; however, when two small economies join a larger one, FTAs can become necessary for global free trade.

To conclude, one strategy is to pursue more clear and operational labelling rules through trade agreements to reduce trade barriers (Smyth et al., 2017). Another strategy is to influence demand for the new regulation by increasing awareness on its pros and cons. Therefore, specific programs that improve the knowledge of consumers in developing and less developed countries are recommended. The profit retained from consumer demand of standardized products should cover the additional cost of product certification and increase international trade on a global scale.

6.3.2 Ecolabelling in global perspective

At the global level, ecolabelling schemes have increased throughout the last three decades (Devi Juwaheer et al., 2012a, 2012b). Nordic Swan in Nordic countries, EU Flower in EU countries, Energy Star in the US, Eco-Mark in Japan and India, Environmental Choice in Canada and New Zealand, Green Label in Singapore and Thailand, and Environmental Label in China are some examples of such schemes (Shen, 2012). At the same time, the uptaking of ecolabelling among producers has also increased. For example, in Denmark, the number of Nordic Swan ecolabelled products increased from 3,021 in 2008 to 7,173 in 2013 (Jørgensen and Moen, 2015). Although the main objective of ecolabelling is environmental protection, it may also create a trade barrier in the international trade system. Changes in consumer awareness lead to changes in consumer purchasing behavior. As such, global trade will be impacted more and more each year (Lee, 2016). Hence, there are concerns among trade organizations, such as the WTO, about considering ecolabelling as a significant influencer on trade.

In the background section, we discussed how the diversity of environmental labels complicates consumer purchasing decisions. The issue becomes more complex when products are not produced domestically and are labelled in such a way that consumers are unfamiliar with the label. The literature shows that the matter is more critical when the label is implemented in developing countries. Compared to developed countries, developing countries are found to be slower and less motivated to promote the ecolabelling of their products (Melser and Robertson, 2005). For example, in their research on the ecolabelling of forest products in developing

countries, Durst et al. (2006) suggest that only 5% of all certified products are produced in lower-income countries (in particular, tropical countries), while the majority of certified products are produced in North American and European countries (91.8%). Applying ecolabelling standards in some developing countries imposes additional costs and restrictions on export and trade (Basu et al., 2004; Durst et al., 2006). One example is the tuna/dolphin dispute between the US and Mexico, which demonstrates a critical aspect of this conflict:

"The U.S. southern neighbor believes that the Dolphin Safe Policy is too restrictive and in 2008, it filed a multi-faceted complaint with the WTO, saying that the regulations are inconsistent, discriminatory and unnecessary. The WTO decided that the U.S. Dolphin Safe Policy does not discriminate against Mexico" (Wright, 2011).

Using the Nash competition model for importing and exporting countries, Basu et al. (2007) show that the lack of ecolabelling has a significant pro-trade bias, especially when a rich importing country applies higher product standards. They also find that importing countries overestimate profits from ecolabelled products. The authors explain that importers choose higher labelling standards without recognizing that these standards will impose expenses on exporters. In contrast, exporters tend to choose lower labelling standards. The authors show that ecolabelling may reduce income, especially for poorer countries. In addition, they conclude that the impact of ecolabelling on trade may be even bigger when the incomes of two trading countries are sufficiently different. Pérez-Ramírez et al. (2010) believe that certificates (e.g., MSC) are expensive for most developing countries and suggest offering assistance to less developed countries to promote participation in standards for fisheries. Moreover, evidence from India (Thomsen and McAloone, 2015) and Colombia (Gaviria, 1995) illustrates difficulties in adopting environmental requirements for products and services in these countries.

Despite the slow uptake and high cost of ecolabelling, studies show that producers in developing countries benefit from ecolabelling certifications. Carlson and Palmer (2016) conducted a study on the Forest Stewardship Council (FSC) and Marine Stewardship Council (MSC) certification in developing countries. Their results indicated that ecolabelling benefited governance in developing countries, which compensated for the expenses of ecolabelling certification.

In the fishing industry, developing countries face new regulations on their exports. As the world's leading fish producer (32.5%), followed by Japan, India, the United States and Russia, China is challenging new barriers on the country's exports to developed countries (Gulbrandsen, 2005; Lackey, 2005). For example, between 2006 and 2008, the US Food and Drug Administration suspended imports of some Chinese food items including seafood (which amounted to 37.5% of the exported food). During the same period, the European Imported Alarm System reported that 16% of seafood imported from China did not meet food-safety regulations (Xu et al., 2012). To remain competitive, the Chinese government introduced a number of seafood qualification standards known as "green labels". Latin American countries, Vietnam, Bangladesh and Indonesia, which are also large producers of tuna products, are struggling to obtain ecolabel (e.g., MSC) certifications (Pérez-Ramírez et al., 2010; Duggan and Kochen, 2016).

6.4 Research questions and hypotheses

Ecolabels are a form of private product regulation (Castka & Corbett, 2014; Henson, 2011; Smith & Fischlein, 2010) and are not necessarily (and always) conducted by governmental institutions. On the contrary, with tariffs and many other non-tariff regulations that are regulated by governments to improve international trade, ecolabelling is not under government control. The creation of more than 400 ecolabels complicates consumers' selection of an appropriate ecolabel and creates competition among ecolabelling organizations. Hence, ecolabelling may have negative impacts on trade.

This study aims to explore the impacts of foreign ecolabels on export to Canada. We selected ISO environmental management standards, compared to ECOLOGO, which is practiced in Canada. Canada is the second country to have established an environmental program with its own ecolabels. As Figure 6.2 shows, few Canadian firms have obtained the ISO 14001 certifications. The reason may be that companies that implemented ECOLOGO in their products or services are not motivated to apply for ISO 14001 certificates. Hence, the assumption is that Canadian consumers know ECOLOGO as a trusted environmental program, and therefore Canadian firms are not required to add ISO to compete in the internal market.

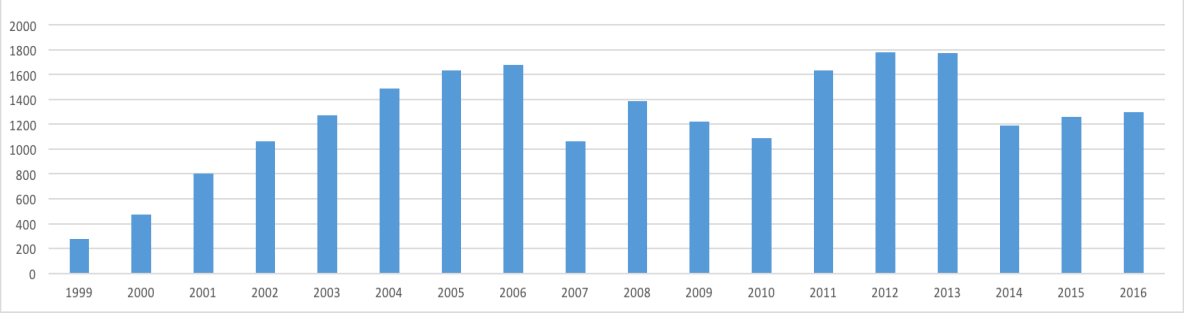

Figure 6.2: Number of ISO 14001 certifications granted to Canadian firms (1999-2016). Source: www.iso.org

The questions raised here are twofold:

(1) We are interested in knowing whether or not ISO 14001 certifications influence imports to Canada as a TBT. To figure it out, we must answer two other sub-questions: (1.1) whether ISO 14001 certifications are recognized as ecolabels by Canadian consumers, and (1.2) whether GEN as a global ecolabelling network helped its members to export to Canada.

(2) We aim to investigate whether non-domestic ecolabels may create barriers to international trade and how the impacts change when holding trade agreements with Canada or WTO membership.

These questions are important for several reasons: first, to know whether or not ecolabelling relatively reduces exports to Canada. We can generalize the answer on exporting to any developed country that has a national ecolabelling program. Many studies tried to clarify the impacts of ecolabelling on international trade as a technical barrier or trade promoter. The question is original in that we investigate trade impacts regardless of the industries and sectors of products and services. For instance, Cohen and Vandenbergh (2012) analyzed carbon product labelling in a green economy, Pérez-Ramírez et al. (2010) studied the fisheries industry, Teisl et al. (2002) investigated tuna products and dolphin-safe ecolabels, and Raynolds (2000) examined the agri-food industry. The focus is more on the role of ISO 14001 as a different ecolabelling program to promote imports to Canada. Second, this question determines the reason why harmonized and universal ecolabelling schemes exist. We analyze the efficiency of participation in universal ecolabelling programs on facilitating international trade. This is why we investigate the role of this certification program in importing to Canada,

a GEN member itself. This article also looks at the impacts of signing a trade agreement with Canada.

Third, it can clarify the impact of an ISO certificate on imports in terms of development. Moreover, we calculate the variability of the market size and income similarity to analyze the side effects of the level of income and development on import to Canada with respect to applying ecolabelling regulations.

Therefore, these are our hypotheses:

Hypothesis 1- Holding the ISO 14001 certification helps to export to Canada.

Hypothesis 2- GEN membership promotes exports to Canada.

6.5 Data and methodology

In terms of methodology, a time-series cross-section analysis is performed. Each cross-section has its own individual features, which may (or may not) influence the predictor variables (Eisenhart, 1947). A Hausman test is performed to see whether time-invariant characteristics are unique to the individuals (Stock and Watson, 2003; Bartels, 2008). And regarding the data, both fixed and random effects models are tested. As a result, the best estimation technique is a set of multilevel linear regressions. As Hox and Kreft (1994) explained: "multilevel models assume a hierarchically structured population, with random sampling of groups both groups and individuals within groups". These models are linear models with (1) fixed effects to take into consideration parameters corresponding to an entire population and (2) random effects, parameters corresponding to individual units drawn at random from a population.

Since multilevel models are selected, some underlying assumptions must be checked. [34]

The estimation technique is thus a set of multilevel models, with some temporal pseudo-replication due to the time-series cross-section (TSCS) dimension of the data. The Generalized

[34] There are five fundamental assumptions for multilevel models: (1) within-group errors are independent with mean zero and variance σ^2, (2) within-group errors are independent of random effects, (3) random effects are normally distributed with mean zero and covariance matric ψ, (4) random effects are independent in different cross-sections, and (5) the covariance matrix does not depend on the cross-section.

Least Squares (GLS) technique (Parks, 1967) is the method that is often used with TSCS data. However, GLS technique for TSCS may produce inaccurate standard errors and violates the Gauss-Markov assumption (Beck and Katz, 1995). Indeed in our data, each country may have its own error variance (heteroscedasticity). To deal with heteroskedasticity, dummy variables are created to represent each country. Thus, each country has its own intercept. Hsaio (1986) shows that fixed effects are suitable if one wants to make inferences to the units observed.

For validity, a set of models is tested. First, to deal with heterogeneity, the random coefficients model (RCM) is used (Beck and Katz, 2006; Swamy, 1970). Regarding our data, the RCM as the "Random Intercepts" (Model 2) is selected to add some more validity to the analysis.[35] Second, the current random model is augmented with time as a fixed effect. Third model is calibrated with time as a predictor of trade inflows and random intercepts across countries (see column "Time RI" - Model 3). Fourth, a next model is calibrated with the effect of time being different across countries (varying slopes across countries) (see the "Time RS" column - Model 4). The fifth model introduces a term that models the covariance structures and errors (see the "Auto Regressive" column - Model 5). Finally, the sixth model adds two interaction variables for each WTO, FTA, and MRA with GEN (see the "Interaction model" column).

The empirical analysis is based on a variant of the gravity model, commonly used to analyze bilateral trade flows. Since the dataset includes missing observations, the actual dataset is unbalanced.

The model is estimated using the following gravity equation and includes Hecksher-Ohlin variables (market size, income similarity) (Warin et al. 2009):

$$EX_{ij,t} = \alpha_o + \beta_1 G_{ij,t} + \beta_2 S_{ij,t} + \beta_3 accFirm_{j,t} + \beta_4 gen_{j,t}$$

$$+ \beta_5 distance_{ij} + \beta_6 comborder_{ij} + \beta_7 comlang_{ij}$$

$$+ \gamma_1 wto_{j,t} + \gamma_2 wtoLength_{j,t}$$

[35] The random part of the model is specified as the name of the country, which means only the intercepts vary across countries.

$$+ \gamma_3 fta_{j,t} + \gamma_4 ftaLength_{j,t}$$

$$+ \gamma_5 \mathrm{mra}_{\mathrm{j,t}} + \gamma_6 \mathrm{mraLength}_{\mathrm{j,t}} \quad (1)$$

Both the Heckscher-Ohlin variables take the following forms:

$$G_{ij,t} = log(GDP_{it} + GDP_{jt}) \quad (2)$$

and,

$$\mathrm{S}_{ij,t} = log\left[1 - (\tfrac{GDP_{it}}{GDP_{it}+GDP_{jt}})^2\text{-}(\tfrac{GDP_{jt}}{GDP_{jt}+GDP_{it}})^2)\right] \quad (3)$$

$accFirm_{j,t}$ represents the sum of ISO 14001 certifications that have been obtained up to year t by the exporter country i. The data is collected from the international organization of standardization (ISO) dataset at the country level.

G is a measure of market size and S represents the market similarity. Warin et al. (2009) applied these indices in a gravity model to analyze bilateral FDI outflows. We use the same strategy to analyze the level of development of exporting countries. In our model, country j represents Canada, and i represents exporting countries. Hence, the greater G, the great the exporting country's GDP. Also, the higher the income similarity measurement, the closer the exporting country i is to Canada's GDP level.

Exports to Canada are collected from the Statistics Canada database in Canadian dollars. The data cover export values of all categories based on the 6-digit commodity level using the harmonized system (HS). The data for geographic distance, common border and common language are obtained from CEPII. The data regarding the FTA and MRA are collected from Global Affairs Canada and Industry Canada. Information about the year of membership for current GEN members are available on the GEN website. Also, the data related to WTO are collected from the WTO database available online.

Variables $wto_{j,t}$, $fta_{j,t}$, $mra_{j,t}$, and $gen_{j,t}$are binary variables. Variable $wto_{j,t}$represents the WTO membership of country j in year t. Variables $fta_{j,t}$ and $mra_{j,t}$ represent the binding of country j respectively in a free trade agreement and mutual recognition agreement with Canada in year t. Variable $gen_{j,t}$ represents the membership of country j to GEN in year t. Further, $wtoLength_{j,t}$ represents the number of years country j has been a WTO member. Also, $ftaLength_{j,t}$ and $mraLength_{j,t}$ are the number of the years that agreements between country j and Canada have been issued.

In model 6, two interaction variables are created. The first variable is the interaction of the length of the agreement by the WTO membership with the GEN membership, and the second variable is the interaction of the number of certifications with the binary variables WTO, FTA and MRA. After running an overall general model in equation (1), we then break the baseline equation (1) into three equations. In the next equation, the WTO factor and WTO-related variables are included. In a further equation, the FTA factor is included and in the third step, the MRA factor is included. The results are presented in three different tables.

6.6 Results

In equation 1, we have three factors: WTO, FTA and MRA, in order to verify their (combined) impacts on exports to Canada. In equation 4, 5 and 6, these factors are added independently from each other. The results are presented in tables 6.3, 6.4 and 6.5, followed by their interpretations. First, we include the WTO membership and the length of the membership as an explanatory variable. The equation is as follows:

$$EX_{ij,t} = \alpha_o + \beta_1 accFirm_{j,t} + \beta_2 gen_{j,t} + \beta_3 G_{ij,t} + \beta_4 S_{ij,t}$$

$$+ \beta_5 distance_{ij} + \beta_6 comborder_{ij} + \beta_7 comlang_{ij}$$

$$+ \gamma_1 wto_{j,t} + \gamma_2 wtoLength_{j,t}$$

$$+ \delta_1 accFirm{:}\, wto_{j,t} + \delta_2 gen{:}\, wtoLength_{j,t} \quad (4)$$

In addition, two interaction variables are added to the equation above. These variables are: $\mathrm{accFirm{:}\,wto_{ij,t}}$ representing the interaction of the number of ISO 14001-certified firms by the end of the corresponding year and the binary variable, which indicates if country j is a WTO member in the corresponding year or not. $\mathrm{gen{:}\,wtoLength_{ij,t}}$ represents the interactions of two variables: the GEN membership and the length of the WTO membership of exporting country j. The impact of the number of ISO 14001 certifications is significantly positive although it is not big enough to conclude that ISO certification is TBT. The GEN coefficient is significantly positive and is also large enough to be considered a facilitator in exporting to Canada. The GEN variable is a binary variable, which takes value 1 if the exporting country has joined GEN in the corresponding year. The coefficient of the length of WTO is not significant in all six methods; however, in the random effect model, the WTO length coefficient is significantly positive. In addition, the market size coefficient in the autoregressive model is significantly positive, therefore the level of development of the exporting countries has a positive relation with exports to Canada.

Table 6.3: Regression result- WTO

	Dependent variable: Export Canada (log) - WTO					
	GLS	RI	Time RI	Time RS	Auto Regression	Interaction Model
accFirms	0.00002***	0.00001***	0.00001***	0.00001***	0.00001***	0.00000
	(0.00002, 0.00002)	(0.00001, 0.00001)	(0.00001, 0.00001)	(0.00001, 0.00001)	(0.00001, 0.00001)	(-0.00001, 0.00001)
gen	0.066	0.162	0.186	0.188*	0.120	0.078
	(-0.012, 0.145)	(-0.058, 0.382)	(-0.036, 0.409)	(-0.034, 0.411)	(-0.124, 0.365)	(-0.198, 0.354)
g	-0.092	0.112	0.091	0.092	0.394**	0.076
	(-0.244, 0.061)	(-0.236, 0.460)	(-0.258, 0.439)	(-0.257, 0.441)	(0.025, 0.763)	(-0.276, 0.428)
s	0.036	0.024	0.014	0.014	-0.078	0.026
	(-0.027, 0.099)	(-0.132, 0.179)	(-0.141, 0.170)	(-0.141, 0.170)	(-0.252, 0.095)	(-0.132, 0.183)
distance	-0.00002***	-0.00001	-0.00002	-0.00002	-0.00002	-0.00002
	(-0.00003, 0.00000)	(-0.00001, 0.00002)	(-0.0001, 0.00002)	(-0.0001, 0.00002)	(-0.0001, 0.00002)	(-0.0001, 0.00002)
comBorder	37.387***	37.501***	37.502***	37.394***	37.729***	37.498***
	(37.014, 37.760)	(36.398, 38.604)	(36.403, 38.601)	(36.295, 38.494)	(35.530, 37.929)	(36.389, 38.608)
comLang	-0.014	-0.060	-0.050	-0.050	-0.056	-0.046
	(-0.085, 0.056)	(-0.264, 0.144)	(-0.254, 0.153)	(-0.254, 0.154)	(-0.281, 0.169)	(-0.252, 0.160)
wto	0.142**	-0.018	0.002	0.002	0.004	0.010
	(0.011, 0.237)	(-0.179, 0.143)	(-0.162, 0.167)	(-0.162, 0.166)	(-0.155, 0.163)	(-0.156, 0.175)
wtoLength	-0.10**	0.007**	0.0003	0.0003	-0.0005	-0.002
	(-0.018, -0.001)	(0.0002, 0.014)	(-0.013, 0.014)	(-0.013, 0.014)	(-0.020, 0.019)	(-0.017, 0.012)
year			0.008	0.008	0.007	0.008
			(-0.005, 0.021)	(-0.005, 0.021)	(-0.013, 0.027)	(-0.006, 0.021)
accFirm:wto						0.00001
						(-0.0001, 0.0001)
gen:wtoLength						0.010
						(-0.004, 0.024)
Constant		-0.982	-16.443	-16.453	-17.791	-16.201
		(-4.868, 2.904)	(-42.305, 9.419)	(-42.359, 9.453)	(-57.472, 21.890)	(-43.464, 11.062)
Time Fixed Effects	No	No	Yes	Yes	Yes	Yes
Observations	1,595	1,595	1,595	1,595	1,595	1,595
Log Likelihood	-1,441.918	-956.591	-955.885	-955.179	-211.620	-954.927
Akaike Inf. Crit.	2,905.837	1,937.182	1,937.769	1,940.358	455.240	1,939.854
Bayesian Inf. Crit.	2,964.958	2,001.677	2,007.639	2,020.977	541.234	2,020.473

The results show that the common border is a significant promoter for exports to Canada. This is normal since the USA is the biggest exporter to Canada. The significant negative coefficient of distance in the GLS method supports the assumption of the traditional gravity model in that distance has negative impacts on trade. The interaction method does not show any significant result for the interaction variables.

For the second model, we replaced the WTO-related indicators (in equation 8) with the FTA-related indicators. Equation 9 implied FTA indicators as follows:

$$EX_{ij,t} = \alpha_o + \beta_1 accFirm_{j,t} + \beta_2 gen_{j,t} + \beta_3 G_{ij,t} + \beta_4 S_{ij,t} + \beta_5 distance_{ij} + \beta_6 comborder_{ij} + \beta_7 comlang_{ij} + \gamma_3 fta_{j,t} + \gamma_4 ftaLength_{j,t} + \delta_3 accFirm{:}\, fta_{j,t} + \delta_4 gen{:}\, ftaLength_{j,t} \quad (5)$$

We included two interaction variables related to FTA. Variable $\mathrm{accFirm{:}\,fta_{ij,t}}$ represents the interaction of the number of ISO 14001-certified firms by the end of the corresponding year and the binary variable that indicates if country j joins a FTA with Canada in the corresponding year. In addition, $\mathrm{gen{:}\,ftaLength_{ij,t}}$ is the interaction of two variables: the GEN membership and the length of FTA for exporting country j.

The result of the FTA model supports the positive impacts of the GEN membership on exports to Canada. The $\mathrm{gen_{j,t}}$ coefficient is more significant in the FTA model than the WTO model. The FTA coefficient is significantly negative (- 0.329) in the autoregressive model; however, the length of the FTA agreement is significantly positive. In most cases it can be explained by the fact that the effectiveness of the trade agreement increases in the following years. Furthermore, the autoregressive method shows a positive significant relation between the size

of the market and exports to Canada; however, there is no strong evidence about the relationship between the similarity of the market and exports to Canada.

The interaction model shows significant results for variables $\mathrm{accFirm:fta_{j,t}}$ and $\mathrm{gen:ftaLength_{j,t}}$. Countries that are GEN members and hold a FTA with Canada are more likely to export to Canada in higher volumes. Also, countries in which there are more ISO 14001-certified firms and which hold a FTA with Canada are more likely to export to Canada. Since the coefficient is much smaller, we can conclude that the impacts of a GEN membership and the length of the FTA with Canada are greater than having ISO 14001-certified firms.

Like the WTO model, the common border of the FTA model has a significant positive coefficient; however, common language and distance do not have significant impacts on exports to Canada. The only country that shares a border with Canada is the US and it is the biggest exporting country to Canada. Therefore, we expected that the common border would be a factor that promotes exports.

Table 6.4: Regression result- FTA

	Dependent variable: Export Canada (log) - FTA					
	GLS	RI	Time RI	Time RS	Auto Regression	Interaction Model
accFirms	0.00002***	0.00001***	0.00001***	0.00001***	0.00001***	0.000001***
	(0.00002, 0.00002)	(0.00001, 0.00001)	(0.00001, 0.00001)	(0.00001, 0.00001)	(0.00001, 0.00001)	(0.00001, 0.00001)
gen	0.155***	0.295***	0.296***	0.297***	0.239**	0.071
	(0.083, 0.228)	(0.084, 0.506)	(0.082, 0.510)	(0.083, 0.510)	(0.022, 0.456)	(-0.159, 0.302)
g	-0.097	0.034	0.031	0.033	0.294*	0.239
	(-0.235, 0.042)	(-0.277, 0.344)	(-0.296, 0.358)	(-0.295, 0.360)	(-0.258, 0.058)	(-0.050, 0.528)
s	-0.005	0.022	0.022	0.022	-0.100	0.169**
	(-0.063, 0.053)	(-0.125, 0.169)	(-0.125, 0.169)	(-0.125, 0.169)	(-0.258, 0.058)	(0.032, 0.307)
distance	-0.00001*	-0.00000	-0.00000	-0.00000	-0.00001	-0.00000
	(-0.00002, 0.00000)	(-0.00004, 0.00003)	(-0.0004, 0.00003)	(-0.0004, 0.00003)	(-0.0004, 0.00003)	(-0.0004, 0.00004)
comBorder	34.684***	33.707***	33.710***	33.604***	33.720***	25.432***
	(34.222, 35.147)	(32.561, 34.852)	(32.560, 34.859)	(32.454, 34.754)	(32.472, 34.969)	(23.946, 26.917)
comLang	-0.001	0.009	0.009	0.009	-0.019	-0.003
	(-0.065, 0.062)	(-0.185, 0.203)	(-0.186, 0.204)	(-0.186, 0.204)	(-0.214, 0.176)	(-0.215, 0.210)
fta	-0.755***	-0.662***	-0.663***	-0.663***	-0.329***	-0.813***
	(-0.986, 0.525)	(-0.847, -0.478)	(-0.847, 0.478)	(-0.848, -0.479)	(-0.522, -0.136)	(0.951, -0.675)
ftaLength	0.183***	0.238***	0.238***	0.238***	0.182***	0.047**
	(0.159, 0.208)	(0.212, 0.264)	(0.212, 0.264)	(0.212, 0.264)	(-0.012, 0.011)	(0.024, 0.070)
year			0.0002	0.0002	-0.001	-0.004
			(-0.006, 0.006)	(-0.006, 0.006)	(-0.012, 0.011)	(-0.009, 0.001)
accFirm:fta						0.0001***
						(0.0001, 0.0001)
gen:ftaLength						0.464***
						(-0.406, 0.523)
Constant		-0.306	-0.631	-0.633	-1.784	5.229
		(-3.793, 3.181)	(-12.595, 11.332)	(-12.591, 11.324)	(-24.713, 21.146)	(-3.855, 14.313)
Time Fixed Effects	No	No	Yes	Yes	Yes	Yes
Observations	1,595	1,595	1,595	1,595	1,595	1,595
Log Likelihood	-1,307.820	-808.644	-808.642	-807.764	-170.851	-361.468
Akaike Inf. Crit.	2,637.640	1,641.288	1,643.285	1,645.528	373.702	752.935
Bayesian Inf. Crit.	2,696.761	1,705.783	1,713.155	1,726.147	459.696	833.555

The third equation (equation 10) includes MRA-related variables.

$$EX_{ij,t} = \alpha_o + \beta_1 accFirm_{j,t} + \beta_2 gen_{j,t} + \beta_3 G_{ij,t} + \beta_4 S_{ij,t}$$

$$+ \beta_5 distance_{ij} + \beta_6 comborder_{ij} + \beta_7 comlang_{ij}$$

$$+ \gamma_5 mra_{j,t} + \gamma_6 mraLength_{j,t}$$

$$+ \delta_5 accFirm{:}\, mra_{j,t} + \delta_6 gen{:}\, mraLength_{j,t} \qquad (6)$$

The results show that ISO 14001 certification has significant positive impacts on exports to Canada; however, like the previous results, this impact is not significant. In relation to MRASs, GEN does not have a significant impact on exports to Canada. In the autoregressive model, MRA has a significant negative coefficient but the MRA length coefficient is significantly positive. Therefore, MRAs promote trade significantly during their activation year.

The coefficient of interaction variable $\mathrm{accFirm{:}\,mra_{j,t}}$ is significantly positive. This means that the number of ISO 14001 certifications in countries holding mutual recognition agreements with Canada is positively related to exports to Canada. Moreover, coefficient $\mathrm{gen{:}\,mraLength_{j,t}}$ is significantly positive and relatively bigger (0.464). This means that countries that are GEN members through their ecolabelling programs and also hold a MRA with Canada, export to Canada more than other countries. This shows the efficiency of both the MRA and GEN in accelerating exports to Canada

Table 6.5: Regression result- MRA

	Dependent variable: Export Canada (log) - MRA					
	GLS	RI	Time RI	Time RS	Auto Regression	Interaction Model
accFirms	0.00002***	0.00001***	0.00001***	0.00001***	0.00001***	0.000000**
	(0.00002, 0.00002)	(0.00001, 0.00001)	(0.00001, 0.00001)	(0.00001, 0.00001)	(0.00001, 0.00001)	(0.0000, 0.0000)
gen	0.072*	0.131	0.151	0.152	0.104	0.022
	(0.005, 0.150)	(-0.089, 0.352)	(-0.073, 0.374)	(-0.071, 0.376)	(-0.139, 0.347)	(-0.213, 0.256)
g	-0.140*	0.054	0.008	0.009	0.358*	-0.052
	(-0.292, 0.013)	(-0.287, 0.395)	(-0.345, 0.360)	(-0.343, 0.362)	(-0.013, 0.729)	(-0.401, 0.296)
s	0.029	0.031	0.021	0.021	-0.079	0.032
	(-0.034, 0.093)	(-0.127, 0.188)	(-0.138, 0.180)	(-0.138, 0.180)	(-0.255, 0.097)	(-0.125, 0.180)
distance	-0.00000	0.00002	0.00002	-0.00002	-0.00000	0.00000
	(-0.00002, 0.00001)	(-0.00002, 0.00001)	(-0.0002, 0.00001)	(-0.0002, 0.0001)	(-0.0005, 0.00004)	(-0.0004, 0.00004)
comBorder	37.425***	37.556***	37.569***	37.473***	36.753***	37.341***
	(37.052, 37.799)	(36.441, 38.671)	(36.456, 38.682)	(36.359, 38.587)	(35.549, 37.958)	(36.244, 38.438)
comLang	-0.039	-0.082	-0.089	-0.088	-0.076	-0.103
	(-0.108, 0.031)	(-0.288, 0.123)	(-0.294, 0.117)	(-0.294, 0.117)	(-0.299, 0.146)	(-0.306, 0.099)
mra	0.235***	0.207*	0.239*	0.238*	-0.021	0.259**
	(0.063, 0.406)	(-0.027, 0.441)	(-0.004, 0.481)	(-0.004, 0.480)	(-0.309, -0.268)	(0.021, 0.497)
mraLength	-0.010	0.019***	0.016*	0.016**	0.021*	-0.013*
	(-0.026, 0.007)	(0.008, 0.030)	(0.003, 0.029)	(0.003, 0.029)	(-0.002, 0.044)	(-0.028, 0.002)
year			0.004	0.004	0.001	0.009**
			(-0.004, 0.012)	(-0.004, 0.012)	(-0.013, 0.015)	(0.001, 0.016)
accFirm:mra						0.0001***
						(0.0001, 0.0001)
gen:mraLength						0.043***
						(0.023, 0.062)
Constant	1.651*	-0.708	-8.183	-8.149	-5.145	-16.653**
	(-0.050, 3.351)	(-4.520, 3.104)	(-23.400, 7.034)	(-23.361, 7.063)	(-32.876, 22.585)	(-31.736, -1.569)
Time Fixed Effects	No	No	Yes	Yes	Yes	Yes
Observations	1,584	1,584	1,584	1,584	1,584	1,584
Log Likelihood	-1,433.155	-946.883	-946.385	-945.750	-213.366	-910.282
Akaike Inf. Crit.	2,888.311	1,917.766	1,918.770	1,921.500	458.731	1,850.564
Bayesian Inf. Crit.	2,947.355	1,982.176	1,988.550	2,002.016	544.614	1,931.080

6.7 Conclusion

Over the last four decades, ecolabelling organizations have earned recognition as an important tool in developing sustainability and environmental protection in the production cycle of products (Prieto-Sandoval et al., 2016; Reisch, 2001). Blue Angel, ECOLOGO (also known as the Environmental Choice Program and EcoLogo) and Nordic ecolabelling are among the first national and supra-regional organizations. The success of these organizations, and the need to align ecolabelling practices, led to the introduction of ISO 14001 by the International Organization for Standardization. The demand for ISO 14001 has increased among producers in different countries.

Another solution strategy to the diversity of ecolabelling programs is the GEN. It invited all ecolabelling organizations to one table to align their ecolabelling programs. The main objective of the GEN is to exchange information among national ecolabelling organizations operating "type 1" ecolabels. The GEN requires its member to exchange information and cooperate with one another to increase the supply and demand for ecolabelled products. The GEN current includes 26 ELOs from both developed and developing countries. As our results show, the GEN significantly promotes exports to Canada, especially for countries with an FTA or MRA with Canada.

Evidence from developing countries such as India, China, Mexico and Colombia show that applying ecolabelling regulations in such countries imposes costs and barriers on their exports to developed countries. Meanwhile, according to previous studies, developing countries benefits from well-known ecolabels such as the Forest Stewardship Certification and Marine Stewardship Certification. Over the last decade, China, as the leader of the fishing industry, and Latin American countries, as the largest producers of tuna products have been having trouble exporting to developed countries. To help these countries, the WTO offered assistance to facilitate the implementation of ecolabelling programs for some developing countries; however, the result on WTO membership does not support evidence of this matter.

CHAPTER 7 GENERAL DISCUSSION

This dissertation had the purpose of investigating the trade impacts of non-tariffs (NTBs) and technical barriers (TBTs) to international trade. Non-tariff barriers and regulations are at the center of global trade. By 2017, almost 96% of the world trade is affected by at least one regulation, which is often referred to as a non-tariff measure (Winters, 2017). By definition, technical regulations, standards and conformity assessments procedures, aim to achieve legitimate public policy objectives, national security, public health and safety and environmental protection. However, in action they may instead become or create barriers to trade when they are implemented non-proportionally, implemented arbitrarily, or enforced through testing and certification requirements that are not clear, unified, or well-published (Kotschwar, 2001). The problem arises when enterprises and countries with lower levels of infrastructure want to compete in the global market. Mutual Recognition Agreements (MTAs), harmonization of standards (such as ISO and GEN), and the WTO TBT Agreement contains rules aimed specifically at preventing regulations and standards from creating unnecessary barriers to trade (CEFTA, 2012).[36] Despite there being significant progress in eliminating the burden aspect of NTBs and TBTs, there are still some perspectives that should be covered. As Mr. Alen Winters (2017) mentioned, analyzing trade related time-series data, ensuring that the data is interpreted accurately, finding useful indices are important components in order to discover the impacts of NTBs and TBTs.[37] The present study applied a data analyze approache in order to accurately evaluate the trade impacts of NTBs, TBTs, and their elimination approaches, on international trade as well as their impact on enterprises perspectives.

This dissertation, first applied a logistic regression approach using World Bank Enterprise Survey. It studied NTBs that are recognized by exporting firms as barriers to trade. Through in-depth analyzing of each NTB, provided insights on the severity of each barrier. The study then took an approach of collecting data in TBTs notifications of main categories (*protection of*

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[36] Report of "Elimination of Non-Tariff Barriers in CEFTA", CEFTA Issues Paper 4, Central European Free Trade Agreement and (CEFTA)

[37] Mr. Alen Winters is Professor of Economics at the University of Sussex, member of the Group of Eminent Persons on Non-Tariff Barriers, and founder of the modern understanding of NTMs.

human and health of safety's, protection environment, and quality requirement) and by using a gravity model, analyzed the impacts of each category of TBTs. Finally, the study chose un-harmonized ecolabelling regulations as an example of TBTs in the category of *the protection of the environment*. Utilizing a gravity model, then it analyzed the impacts of first, the harmonized approaches on ecolabelling regulations: ISO 14001 and Global Ecolabeling Network (GEN), and second, the trade agreement and trade organization which is concerned about ecolabelling: WTO (TBT Agreement), FTA, and MRA.

This chapter presents the key findings of the dissertation recalling that the aim of this research was to address How severely, if at all, do enterprises rate non-tariff barriers as obstacles to trade? (research question 1), differentiated by categories, how do TBTs effect the international trade (research question 2), and how do un-harmonized ecolabelling regulations impact international trade (research question 3).

7.1 NTBs in Enterprise' Perspective: Regarding the Firm-Level and Region

Over the last two decades, a transformation placed firms, rather than countries or industries, as the main unit of analysis (Antràs et Yeaple, 2013). In order to compete in the global market, firms should remain up to date on the newest standards, technical regulations, and related certificates. The cost of applying a new standards or regulations, depends on many factors and varies among firms. These factors include, but are not limited to the following: the type of the product produced by the exporting firms, the amount of regulations placed on each sector (with relatively more placed on agricultural versus the industrial sector); the existence of trade agreements (such as FTAs, MRAs) between the country of origin and destination country or countries; the similarity or commonality of technical regulations which may favour domestic industries and firms of the zone; and membership in a trade organization or union (ex. WTO, EU) through its country of origin.

The first research question, How severely, if at all, do enterprises rate non-tariff barriers as obstacles to trade?, was focused on providing a firm-level analysis of Non-Tariff Barriers' (NTBs) categories based on the importance of exports for domestic firms across diverse regions in the world. It exploits cross-sectional data from the World Bank Enterprise Surveys of 10,266

firms across 81 countries covering the period from 2006 to 2014. Firms are categorized according to the volume of their exports in brackets of 10-25%, 26-50%, 51-75%, and 76-100%. Also, these firms are sorted according to their location geographical categories are East Asia & Pacific, Europe & central Asia, Latin America & Caribbean, Middle East & North Africa, South Asia, and Sub-Saharan Africa. The survey responses refer both NTBs of the destinations and home countries. Depending on the NTB. For instance, NTB1 is the customs and trade regulation, imposed by home and destination country. Versus NTB2, tax rates that refers to the tax imposed by home country. The survey asked questions about the main NTBs those firms in home countries face in order to export.

The study focused on four NTBs: customs and trade regulations, tax rate, tax administration, and business licensing and permits. Firms were analyzed according to volumes of exportation and locations. We adjusted the NTBs to binary variables by giving the value of 1 to severe obstacles (value 4) and 0 to all other categories (0, 1, 2, and 3), and we estimated the odds for different levels of exports across different regions.[38] The NTBs: *business licensing and permits* (NTB4) and tax rate (NTB2) are more likely to be ranked as severe barriers for the firms with 51-75% level of exports. This suggests that firms with higher levels of exports have to challenge more with these NTBs. However, the question raises here is that the firms in lower levels of export suffer from NTBs or the NTBs create barrier for firms therefore they cannot increase their export. We assume that the barriers restrict their ability to use their full capacity to export. The majority of the firms with 26-50% of exports are more likely to rank *tax administration* (NTB3) as a severe barrier (significant for 4 regions). *Tax administration* refers to the barriers of tax administers of home countries. Therefore, it is different across countries and regions. This result is similar to *customs and trade regulation* (significant for 2 regions). *Customs and trade regulations* are barriers imposed by home and destination countries. Results show this NTB discourages the firms in second level of exports (26-50%). Applying trade regulations can be costly for firms with low revenue.

[38] It would be interesting to analyse NTBs in other classification. For instance, give value 1 to very severe and major obstacle (value 3 and 4), and value 0 to otherwise (thanks to Dr. Sophie Bernard for the idea)

In general, the findings suggest that the severity of the NTBs vary upon the location and the level of exportation of the firms. For example, the tax rate is the most credible NTB to be chosen as a severe barrier by firms in most of the regions, or in regions such as East Asia and sub-Saharan Africa. Alternately, customs and trade regulations and tax administration are more likely to be rated as very severe barriers.

The comparison between the NTBs shows that NTBs: *tax rate* (NTB2) and *business licensing and permits* (NTB4) are more likely to be rated as a severe barriers (rated as 4), while *tax administration* (NTB3) and *customs and trade regulation* (NTB1) have higher probability to be ranked as minor or no obstacle to trade. The result draws some policy lessons for governments, international trade negotiators, and multinational organizations interested in the economic development of emerging and least development countries.

Moreover, the results show that the firms in higher levels of exportation are more likely to rank the NTBs as severe barriers to trade, compared to the firms in lower levels of exportation. This issue of diversity, in response to the NTBs across firms and regions, guided this dissertation to its second research question that addresses the trade impacts of TBTs that are differentiated by categories.

7.2 Trade Impacts of TBTs: Regarding Categories and Sectors

Previous studies present a difference between the impacts of the TBTs in agricultural and industrial (or non-agriculture) sectors. Most of the studies show TBTs having a higher negative impact on the agricultural sector than the industrial sector (for example: Swann et al., 1996; Yoon et al., 2014). Moreover, regarding the WTO TBT Agreement, TBTs are categories based on their primary objectives. As the first step of eliminating TBTs, is to analyze their impacts on international trade, this dissertation looked for the trade impacts of three main categories of TBTs in two main sectors. Therefore, the second question was defined as: differentiated by categories, how do TBTs affect the international trade?

The second research question attempted to point out how TBTs of different categories impacted on trade between developed and emerging countries, specifically in the two sectors of agricultural and industrial. To address this question, a database that classifies TBTs based on the primary objective (category) and the sector was conducted. The article chose the first three TBTs

containing more notifications: protection of human and health or safety's (TBT1), protection of the environment (TBT2), and quality requirements (TBT3). The database includes the exports in agricultural and industrial sectors from China (emerging country) and the US (developed country) to the members of European Union covering the period from 2001 to 2015 as the dependent variable. Other factors such as the length of the EU membership, market size, market similarity, and distance, are included in the applied gravity model. The results are quite different between the trade impacts of TBT on exports of US and China to the EU. Table 7.1 shows the summary of significant result for the second question.

Table 7.1: Summary of results- research question 2

TBT	**Trade impacts (2008-2015)**
Protection of human and health or safety's	Positive impact on agricultural sectors
	Negative impacts on industrial sectors
Protection of the environment	Negative impacts on agricultural sectors
	Positive impacts on imports from China in industrial sectors
	Negative impacts on imports from the US in industrial sectors
Quality requirements	Negative impacts on imports from the US in agricultural sectors
	Positive impacts on imports from China in industrial sectors
	Negative impacts on imports from the US in industrial sectors

The findings confirmed that trade impacts of the TBTs with dissimilar primary objective, is not the same as well as NTBs in different categories. The TBT "*protection of human and health or safety's"* has negative impacts on imports in both sectors from China. China is the second largest partner for exports in 2016 (10% of all exports), after the US. Except for the drop recorded in 2009 (as a result of financial crisis), the value of the EU imports of goods from China has almost continuously increased over the last decades. However, studies on imports from China show negative impacts of TBTs (Zhang and Liu, 2002; Hu et al., 2017). Our findings confirm that

TBTs notifications of "*protection of human and health or safety's"* have negative impacts on imports from China (and the US) in industrial sectors but positive impacts in agricultural sectors. Since the EU's main imports from China are industrial and consumer goods, machinery and equipment, and footwear and clothing, it is important to consider the burden impact of TBTs in the category "*protection of human and health or safety's".* The impacts of TBTs in other two categories on imports from China in industrial sectors are positive.

The result shows TBT "category *the protection of the environment* and *quality requirements"* creates barriers on imports from both China and the US in industrial sectors. This category includes the environmental labeling such as ecolabelling. The findings and the growing concerns on environmental friendly labelling (especially in Canada) directed this research to its third question.

7.3 Approaches to eliminate negative trade impacts of ecolabelling: Harmonization of Ecolabelling Programs

There are three international approaches on reducing the negative impacts of TBTs on trade: harmonization, the WTO TBT agreement, and the Mutual Recognition Agreements (MRAs). Efforts to harmonize national regulations to international regulations promise concrete benefits through trade expansion (Czubala et al, 2009). Previous studies show contrary results on the efficiency of harmonization approaches in eliminating the negative impacts of TBTs. Some studies show that harmonization fails to decrease the negative impacts of TBTs on trade (Chen and Mattoo, 2008; Xiong and Beghin, 2011), and some studies show that harmonization could eliminate the negative trade impacts of TBTs altogether (For example De Frahan and Vancauteren, 2006).

There are two different debates in harmonization; first between trade globalization defendants and environmental groups, and second between developed and developing countries (Mayeda, 2004). Developed countries are not happy about international harmonization that forces them to adopt lower standards, and developing countries consider compliance with technical regulations and standards to be barriers to their exports and international trade. However, after the Uruguay Round and WTO agreements on TBT and SPS, the strategies have been changed from eliminating technical barriers to improving the infrastructure and creating new institutions in

countries that need them. An example of this debate is whether or not environmentally friendly measures such as ecolabelling are effective. Developing countries need to apply ecolabelling measures to prevent losing competition in worldwide trade. However, un-harmonized regulations on ecolabelling complicate the selection of appropriate regulations to apply.

The variety of ecolabelling schemes called for standardization and unification of practices resulting in the creation of the ISO 14001 standard. The ISO certification requires substantial investments of resources, which can be a problem for producers in less developed countries and, thus, create barriers to trade. To further harmonize international ecolabelling schemes, the Global Ecolabelling Network (GEN) sets up certification criteria and improves information exchange among its country members. Canada, as a member of the GEN, also included environmental assessments in its trade negotiations in order to fulfill objectives on environmental protection, with the most recent trade agreements containing a chapter on the environment.

The third research question addressed how un-harmonized regulations on ecolabelling impacts international trade. For this purpose, we created a database that counts the ISO 14001 certifications obtained by countries that are exporting to Canada. The dependent variable is the exports from 153 countries to Canada covering the period from 2001 to 2015. The independent variables included market size, market similarity, distance, GEN membership of the exporting country, WTO membership and the length of WTO membership, binding in FTA and MRA with Canada and the length of these agreements. GEN is an ecolabelling organization that aims to create harmonization among ecolabelling programs which operate "type 1" ecolabels. The GEN requires its members to exchange information and cooperate with one another in order to increase the supply and demand for ecolabelled products. The GEN currently includes 26 ELOs from both developed and developing countries. In addition to GEN, ISO as an international standard organization, launched ISO 14001 in order to issue some requirements in order to unify the environmental management systems.

As the results show, the GEN membership, as coordination approach, has a significant positive relationship with exportation to Canada. Similarly, the ISO 14001 certification has a significant positive relationship with exportation to Canada, however the coefficient is not large. The other indicators in the gravity model are also following the same trend of the previous studies. For

instance, the common border has a significant impact. Reason being that the only country that has common border with Canada is the US, which is also the biggest exporter to Canada.

The findings show that holding the ISO 14001 certifications, as a standardization approach, has positive relations with exports to Canada, however, the impacts are not large enough that lacking ISO 14001 certifications creates a barrier to trade. In addition, the membership of the GEN significantly promotes the exports to Canada, especially for the countries that bind in an FTA or MRA with Canada. Overall, the results show that participation in both approaches to harmonization (GEN and ISO) increases exports to Canada but that GEN has a bigger impact than ISO. However, the bigger impact of GEN can be because of low demand of ISO 14001 in North America.

Many countries accepted ISO 14001 as a universal environmental certificate (Hall et al., 2015). Firms in developing countries have been actively applying for ISO 14001 certifications in order to access the global market. However, the response to ISO certifications is not the same in North American countries (Jiang & Bansal, 2003). However, despite this lack of interest in certifications from its government, demand for eco-labeled products is significant among Canadian consumers (Lay, 2012). Therefore, there is lack of knowledge about ISO environment certifications. A problem which can be easily remedied by increased media coverage of environmental ecolabels and introducing competition among eco-labelling products on the market.

CHAPTER 8 CONCLUSION AND RECOMMENDATIONS

Over the last few decades, non-tariff and technical barriers have replaced traditional barriers to trade. NTBs and TBTs are barriers which act as a type of trade control by protecting national security, animals and the environment, health and safety, preventing foreign fraud and ensuring product quality. Hence, the NTBs and TBTs have two sorts of impacts: trade restrictive and welfare improving. The complex determination of impacts of NTBs and TBTs on trade, call for more academic research on the topic. This dissertation targeted the trade impacts of NTBs with the focus on TBTs' impacts on trade. The probability of rating the severity negative impacts of NTBs as high varies upon the location and the level of exportation of the firms. Through analyzing the trade impacts of TBTs, differentiated by categories, this dissertation found that each category has differing impacts on trade. For example, the category of *protection of human and health or safety* impacts positively, while the category of *protection of the environment and quality requirements* impacts negatively. Furthermore, the study chose ecolabelling as an example of un-harmonized technical regulation, and investigated eliminating approaches like WTO TBT Agreement, FTAs, and MRAs. Harmonization approaches on ecolabelling regulations could promote the trade, especially for the countries that bind in an FTA or MRA with Canada. This chapter summarizes the dissertation's contributions, recommendations and outlines the research limitations that call for further studies in the effects of TBTs and NTBs.

8.1 Dissertation contributions

This dissertation is a significant contribution to the relatively new research field exploring the impacts of NTBs, TBTs, eco-labelling, and trade agreements in the context of international trade. Regarding its theoretical contribution, this dissertation studied the trade impacts of TBTs differentiated by their categories. Moreover, the dissertation compared the impacts between sectors of agriculture and manufacturing. The study also compared the trade impacts of each category on developed countries with the trade impacts on emerging countries. Based on the gaps found in the current body of literature on the subject, this research focused on the primary objective of NTBs and TBTs, and compared the trade impacts they have had on international markets. While previous studies mainly focused on one specific product or industry, this study compared the trade impacts of TBTs between all products in the agricultural sector, with all

products of the industrial sector. With regard to its practical contributions, this dissertation enriches current research on the harmonization of ecolabelling regulations. It is important to note that consumers across the world have had increasing environmental concerns with each passing decade, yet trust in unknown ecolabels remain low. Therefore, this dissertation has sought to bring to light the consequences of discontinuity by also investigating harmonization approaches of organizations and agreements such as GEN, WTO TBT Agreement, FTAs, and MRAs, and their effects on ecolabelling programs.

The other major contribution of this dissertation is the creation of a database, used in order to analyze the trade impacts of TBTs as differentiated by their categories. I created the database using the counting regulations approach. By adding up the number of regulations (notifications) issued in the WTO TBT Agreement, in each year and by each respective sector, the database provides numerical data which formed the basis for my analysis. The TBT regulations are classified by the product sectors they cover. The databases cover 96 classifications on agricultural and industrial products at the HS2-digit level. The products under HS code of 01 to 24 belong to the agricultural sectors and the products under HS codes of 24 to 95 belongs to the industrial sectors. Therefore, the database compiles the number of TBT protocols issued in six categories (primary objectives regarding TBT Agreement) and in two sectors of agriculture and manufacturing. At the time of study, to my knowledge, there was no database in existence which categorized the number of TBT notifications base on these mentioned categories. The database therefore creates new opportunities for future and further research in this timely and globally relevant matter.

8.2 Recommendations for practical implementation

The findings of this dissertation are useful for managers and decision makers dealing with international and global markets, both in private enterprises and governments alike. At the firm level, the decision of entering the global market needs a clear image of potential cost and probable advantages of a new regulation or standard. Finding the balance point between benefits and cost of applying NTBs and TBTs has not been easy for firms. This dissertation located the regions that NTBs are considered more severe barriers in order to point decision makers in trade organizations (like the WTO) in the direction of those in more need of technical assistance.

The findings are interesting for managers in multinational organizations. Knowing which NTBs are more challenging in which regions can give insight to business planners on where to settle their organizations, or which markets are less challenging. For instance, the tax rate is a severe barrier for firms in east Asia, therefore, the decision makers have to give more weight to this barrier in their business plans.

Trade liberalization is still the most important approach to global development. Results of this study are helpful in order to monitor the problematic TBTs for countries in lower levels of development. Countries with larger GDP gaps with the destination market are expected to face more difficulty in implementation of new regulations. Ambassadors of trade agreements (like the TBT Agreement and MRAs) are suggested to use the finding of this study in order to help under developed countries to join the global market.

The results are in favor of public welfare with regards to environmental protection. The first objective of TBTs is welfare improvement. Dedicating a chapter to environmental protections (including ecolabelling) in the FTAs, MRAs and TBT agreements, shows the importance of such regulations. Therefore, the results provide some insights to public policy makers to choose which approach in order to eliminate or decrease the negative impacts of environmental regulations, without removing such regulations.

8.3 Limitations and recommendations for further research

This research is subject to some limitations which could provide opportunities for further research. First, the quantification of trade impacts of TBTs is very complicated as there is no unified approach to TBT measurement. Despite the difference between TBTs and other categories of NTBs, the majority of previous studies applied the same methodology of NTBs quantification for TBTs. Second, collecting the data on TBT regulations is very challenging. This study collected data from the TBT Agreement, which required reading all the articles issued in the agreements, counting the written notifications and transferring them into numerical values. Another challenging aspect of this study was classifying TBT notifications by their primary objectives and sectors. Third, studies on environmental regulations are largely limited to sustainable labels (such as Marine Stewardships) and for major market players like China and the US where significant data is available. Furthermore, to our knowledge no other study has

analyzed the combined impacts of GEN, WTO, FTAs, and MRAs with an ecolabel (ISO 14001). Hence, there are no references with which to verify the results in this matter. Fourth, bilateral, multilateral, and regional trade agreements are ever increasing, however, not all of them have been studied in order to verify their approach to removing potentially negative trade impacts of TBTs.

Further studies might examine the separate trade impacts of more TBT categories on international trade. This study examined the first three large categories of TBTs, however the results were not as expected in that a category had positive impacts and two categories negative impacts. Moreover, the variety of classifications on TBTs and NTBs complicated the process of choosing which was most appropriate in any country's given circumstance. As the aim of this study was to explore the trade impacts of NTBs and TBTs, it applied the WTO classification. Therefore, an interesting way forward would be to examine the TBTs in other classifications, especially if the welfare impacts of NTBs and TBTs are of interest. And finally, future studies could verify the efficiency of trade agreements in eliminating the negative impacts of TBTs.

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APPENDIX A – QUESTIONS CONCERNING NTBS IN ENTERPRISE SURVEY

The questionnaire required the firms to indicate the degree of each obstacle through the following questions:

1) To what degree is **customs and trade regulation** an obstacle to the current operations of this establishment? (id: D30)

2) What is the degree to which you think **tax rate** is an obstacle to the current operations of this establishment? (id: j30a)

3) What is the degree to which you think **tax administration** is an obstacle to the current operations of this establishment? (id: j30b)

4) What is the degree to which you think **business licensing and permits** is an obstacle to the current operations of this establishment? (id: J30c).

(SOURCE: WWW.ENTERPRISESURVEYS.ORG)

APPENDIX B – PREDICTED VALUES- RESULTS OF REGRESSION OF THE NTBS

TableB.1: Results of regression of the NTB1

		N	NTB1>=1	NTB1>=2	NTB1>=3	NTB1>=4
Region	EastAsia&Pacific	1702	Inf	0.228962	-1.03537	-2.17910
	EuropeCentralAsia	3297	Inf	0.089231	0.670033	-1.58024
	LatinAmerciaCaribbean	3146	Inf	0.953752	0.057231	-1.18084
	MiddleEast&NorthAfrica	427	Inf	0.423061	-0.492134	-1.79176
	SouthAsia	459	Inf	0.950089	-0.144040	-1.14267
	SubSaharanAfrica	1234	Inf	0.760782	0.152646	-1.08354
Export	(10-25)%	3452	Inf	0.548707	-0.363151	-1.44603
	(26-50)%	2509	Inf	0.591385	-0.343719	-1.49921
	(51-75)%	1068	Inf	0.449359	-0.324926	-1.40158
	(76-100)%	3236	Inf	0.372608	-0.502265	-1.415915
Overall		10265	Inf	0.492320	-0.397756	-1.4445

N=10265, 1 Missing

Table B.2: Results of regression of the NTB2

		N	NTB2>=1	NTB2>=2	NTB2>=3	NTB2>=4
Region	EastAsia&Pacific	1702	Inf	0.28391	-0.763618	-1.939212
	EuropeCentralAsia	3297	Inf	1.56744	0.738537	-0.337408
	LatinAmerciaCaribbean	3146	Inf	1.73935	0.909847	-0.448568
	MiddleEast&NorthAfrica	427	Inf	1.89085	0.782333	-0.089052
	SouthAsia	459	Inf	1.40827	0.434664	-0.641187
	SubSaharanAfrica	1234	Inf	0.87252	0.038903	-0.930516
Export	(10-25)%	3452	Inf	1.42736	0.648715	-0.445219
	(26-50)%	2509	Inf	1.34156	0.497032	-0.650992
	(51-75)%	1068	Inf	1.31525	0.465137	-0.659625
	(76-100)%	3236	Inf	1.00792	0.141814	-0.874681
Overall		10265	Inf	1.25382	-0.428496	-0.648463

N=10264, 2 Missing

Table B.3: Results of regression of the NTB3

		N	NTB3>=1	NTB3>=2	NTB3>=3	NTB3>=4
Region	EastAsia&Pacific	1702	Inf	0.15070	-1.041454	-2.427748
	EuropeCentralAsia	3297	Inf	0.74687	-0.092878	-1.269807
	LatinAmerciaCaribbean	3146	Inf	1.63328	0.6912406	-0.804968
	MiddleEast&NorthAfrica	427	Inf	0.86416	-0.042360	-1.245216
	SouthAsia	459	Inf	0.95187	0.0263173	-1.122143
	SubSaharanAfrica	1234	Inf	0.74960	-0.214760	-1.301347
Export	(10-25)%	3452	Inf	1.01239	0.161416	-1.0863
	(26-50)%	2509	Inf	0.90377	0.078190	-1.203455
	(51-75)%	1068	Inf	0.99202	0.035618	-1.247950
	(76-100)%	3236	Inf	0.71363	-0.280829	-1.446537
Overall		10265	Inf	0.87906	-0.0109163	-1.239280

N=10260, 6 Missing

Table B.4 Results of regression of the NTB4

		N	NTB4>=1	NTB4>=2	NTB4>=3	NTB4>=4
Region	EastAsia&Pacific	1702	Inf	-0.55685	-1.841299	-3.275317
	EuropeCentralAsia	3297	Inf	0.154996	-0.579210	-1.747865
	LatinAmerciaCaribbean	3146	Inf	0.790122	-0.173351	-1.443291
	MiddleEast&NorthAfrica	427	Inf	0.967926	-0.004709	-1.258824
	SouthAsia	459	Inf	0.388371	-0.513262	-1.659588
	SubSaharanAfrica	1234	Inf	0.461847	-0.5134197	-1.666936
Export	(10-25)%	3452	Inf	0.42901	-0.4486653	-1.655728
	(26-50)%	2509	Inf	0.32664	-0.5372833	-1.665008
	(51-75)%	1068	Inf	0.31622	-0.5729198	-1.808289
	(76-100)%	3236	Inf	0.14185	-0.7415248	-1.924783
Overall		10265	Inf	0.30102	-0.5732967	-1.753332

N=10242, 24 Missin

APPENDIX C – DATABASE DESCRIPTION OF ENTERPRISES-CHAPTER 4

Table C.1 : Region: East Asia & Pacific

Economy	NTB1 (%)	NTB2 (%)	NTB3 (%)	NTB4 (%)	Number of firms	Year	Size
East Asia & Pacific	12	19.6	12.3	10.5			
China	0.6	6.3	3.5	1.5	2700	2012	593s 1081m 1026 l
Fiji	10.5	26.6	16.1	6.0	164	2009	78s 60m 26 l
Indonesia	11.5	14.3	8.0	6.6	1320	2009	482s 452m 386 l
Lao PDR	3.6	33.4	2.8	2.0	368	2012	217s 104m 47 l
Micronesia	17.9	22.7	23.9	6.2	68	2009	44s 24 m
Mongolia	19.3	29	9	19.5	360	2013	183s 141m 36 l
Myanmar	7.5	6.5	5.5	2.3	607	2013	362s 161m 84 l
Philippines	9.8	26.4	20.8	12.6	1335	2009	418s 514m 403 l
Samoa	18.9	33.5	19.7	3.8	109	2009	69s 35m 5 l
Tonga	8.3	16.6	8	0.1	150	2009	131s 19m
Vietnam	6.9	4.3	5.8	2.4	2009	996	335s 383m 278 l

Table C.2: Region: Europe & Central Asia

Economy	NTB1 (%)	NTB2 (%)	NTB3 (%)	NTB4 (%)	Number of firms	Year	Size
Europe & Central Asia	9.1	26.6	14.9	6.1			
Albania	2	12.8	13.1	3.5	360	2013	274s 64m 22 l
Armenia	19.8	36.8	29.3	4.7	360	2013	175s 137m 48 l
Azerbaijan	1.3	4	4.7	3.4	390	2013	280s 147m 35 l
Belarus	9.9	24.7	4.3	8	360	2013	195s 99m 66 l
Bosnia and Herzegovina	5.7	20.3	13.1	8.4	360	2013	210s 109m 41 l
Bulgaria	3.1	13	11.4	11.1	293	2013	174s 79m 40 l
Croatia	9.1	45.9	22.6	5.8	360	2013	209s 113m 38 l
Georgia	2.9	27.1	6.6	0	360	2013	237s 96m 27 l
Kazakhstan	5.3	11.2	5.5	4.7	600	2013	303s 223m 74 l
Kosovo	34.2	30.2	28.2	4.6	202	2013	116s 73m 13 l
Kyrgyz Republic	12.3	28.9	21.1	6.3	270	2013	101s 127m 42 l
Macedonia	6.6	16	10.3	5.1	360	2013	246s 94m 20 l
Moldova	17.5	13.4	4.5	5.4	360	2013	213s 113m 34 l
Montenegro	3	8.7	2.7	0.3	150	2013	99s 35m 16 l
Romania	11.3	73.8	48.9	12.6	540	2013	316s 155m 69 l
Russian Federation	16	59.1	14.2	15.6	4220	2012	2228s 1487m 505 l
Serbia	4.9	25.5	17.4	3.7	360	2013	196s 112m 52 l
Tajikistan	9.7	31	28.7	11.2	359	2013	182s 140m 37 l
Turkey	5	24.2	11.8	6.8	1334	2013	549s 484m 311 l
Ukraine	8.6	42.9	15.2	5.4	1002	2013	513s 346m 143 l

Table C.3: Region: Latin America & Caribbean

Economy	NTB1 (%)	NTB2 (%)	NTB3 (%)	NTB4 (%)	Number of firms	Year	Size
Latin America & Caribbean	19.5	35.5	23.6	18.3			
Argentina	16.9	62.4	40.4	21.3	1054	2010	336s 395m 323 l
Belize	44.6	56.7	25.5	24.6	150	2010	79s 61m 10 l
Brazil	29.2	81.5	71.4	48.4	1802	2009	678s 678 m 374 l
Colombia	6.7	39.2	28.6	10.5	942	2010	349 s 326m 267 l
Costa Rica	5.8	36.7	24.7	29.3	538	2010	199s 216 m 123 l
Dominica	17.5	22.7	0.4	1.3	150	2010	103s 43m 4 l
Grenada					153	2010	99s 41m 13 l
Guatemala	23.2	30.4	23.5	11.1	590	2010	22s 185m 184 l
Guyana	24.6	50.6	21.6	13.2	165	2010	51s 72m 42 l
Jamaica	14.9	72.9	43.4	13.8	376	2010	140s 169m 67 l
Mexico	5.3	38.5	27.1	28	1480	2010	502s 472m 506 l
Panama	2.7	2.2	4.6	5.2	365	2010	129s 161m 75 l
Peru	15	17.8	20.2	20.4	365	2010	129s 161m 75 l
St. Lucia	21.3	30.5	7.9	4.8	150	2010	79s 55m 16 l
St. Vincent	22.3	34.9	18.6	9	154	2010	110s 38m 6 l
Suriname	35.8	35.7	16.8	47	152	2010	66s 77m 9 l
Venezuela	24.2	10.6	11	23.2	320	2010	160s 113 m 47 l

Table C.4: Region: South Asia

Economy	NTB1 (%)	NTB2 (%)	NTB3 (%)	NTB4 (%)	Number of firms	Year	size
South Asia	17	26.4	18.8	15.9			
Afghanistan	46.5	45.9	39.1	27.6	410	2014	256s 123m 31 l
Bangladesh	6.2	7.3	10.8	9	1442	2013	498s 515m 429 l
India	8.1	23.9	12.2	11.5	9281	2014	2845s 4133m 2303 L
Nepal	17.7	11.2	9.2	9.9	482	2013	283s 147m 52 l
Pakistan	21.4	54.1	34.1	24.5	1247	2013	509s 471m 267 l
Sri Lanka	10.5	26.9	19.1	19.7	610	2011	317s 178m 115 l

Table C.5: Region: Middle East & North Africa

Economy	NTB1 (%)	NTB2 (%)	NTB3 (%)	NTB4 (%)	No. of firms surveyed	Year	Size
Middle East & North Africa	22.7	32.3	22.4	19.3			
Djibouti	21.8	25.2	20	12.2	266	2013	169s 79m 18 l
Iraq	23.4	40	29.5	39.8	756	2011	592s 157m 7 l
Jordan	15	28.1	13.4	10.5	573	2013	226s 181m 126 l
Lebanon	25.9	27.4	14.2	7.3	561	2013	264s 207m 90 l
Morocco	25	31.5	24.9	14	407	2013	141s 153m

Tunisia	9.3	15.9	13.6	2.8	592	2013	113 l 199s 156 l	237m
West Bank & Gaza	33.7	35.2	24.1	26.9	434	2013	292s 23	119m
Yemen	33.7	39.2	32.5	25.7	353	2013	211s 40 l	102m

Table C.6: Region: Sub-Saharan Africa

Economy	NTB1 (%)	NTB2 (%)	NTB3 (%)	NTB4 (%)	No. of firms surveyed	Year	Size
Sub-Saharan Africa	26.4	35.1	29.6	17.9			
Angola	35.8	26.4	30	41.8	360	2010	184s 131m 45 l
Botswana	15.8	16.9	17.6	29.3	268	2010	126s 97m 45 l
Burkina Faso	42.6	75.7	59	17.6	394	2009	226s 108m 60 l
Burundi	35.6	69.9	33.5	5.9	157	2014	81s 64m 12 l
Cab Verde	27.2	51.8	26.6	11.9	156	2009	79s 52m 25 l
Central Africa Republic	31.9	31.9	28.2	18.7	150	2011	99s 40m 11 l
Chad	57.4	59.7	52.9	36.6	150	2009	77s 54m 19 l
Congo	25.3	27.9	38.4	23.1	529	2013	385s 119m 25 l
Congo Rep	45.9	40.9	47.3	28.7	151	2009	84s 51m 16 l
Eritrea	2	1.1	0.4	6.2	179	2009	116s 55m 8 l
Gabon	35.1	30.9	37.3	21.3	179	2009	114s 46m 19 l
Gambia	12.8	30.7	16.5	18.1	174	2006	121s 46m 7 l
Ghana	25.1	52.2	38.2	16.5	720	2013	456s 203m 61 l
Guinea-Bissau	25.6	44	32.8	14.3	159	2006	136s 21m 2 l
Kenya	22.8	18.1	13.8	18.7	781	2013	355s 267m 159 l
Madagascar	13.4	15.6	9.7	5.8	532	2013	321s 128m 83 l
Malawi	26.8	35.6	21.1	11.2	523	2014	291s 148m 84 l
Mauritania	37	49.4	46.2	32	150	2014	73s 62m 25 l
Mauritius	17.6	25.1	16.2	18.6	398	2009	208s 132m 58 l
Mozambique	12.2	30.8	15.7	13.7	479	2007	306s 142m 31 l
Namibia	5.7	20.2	13.9	3.4	580	2014	438s 11m 28 l
Nigeria	14.1	18.5	14.1	9.3	2676	2014	1753s 734m 189 l
Rwanda	18.1	31.3	29.5	7.7	241	2011	114s 90m 37 l
Senegal	13.1	29.2	25.2	7	601	2014	417s 137m 47 l
South Africa	1.9	4.6	2	3	937	2007	361s 376m 200 l
South Sudan	39.6	44.7	27.6	30.7	738	2014	647s 81m 10 l
Sudan	42.1	76.8	71.5	24.7	662	2014	372s 242m 48 l
Tanzania	38.8	41.1	41.2	34.2	813	2013	514s 219m 80 l
Uganda	19.3	21.6	18	15.2	762	2013	487s 209m 66 l
Zambia	8.6	13.7	12.7	9.4	720	2013	437s 225m 58 l
Uzbekistan	2.1	9.3	0.4	1.1	390	2013	145s 148m 97 l

(Source: www.enterprisesurveys.org)

APPENDIX D – HETEROGENEITY OF THE EU MEMBERS- CHAPTER 5

1) United States of America

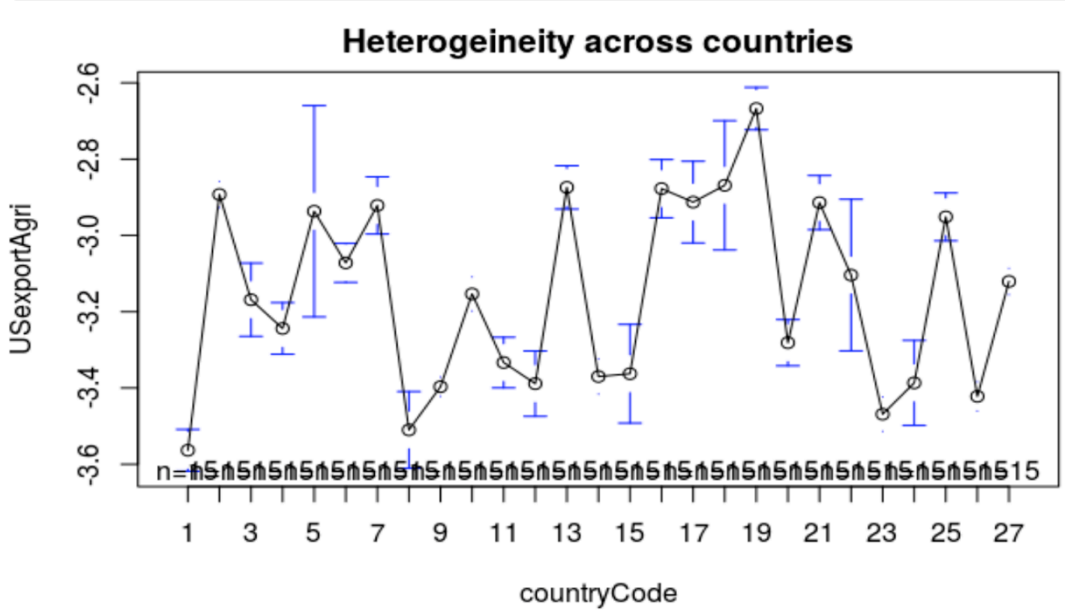

Figure D.1:Exports in agricultural sectors

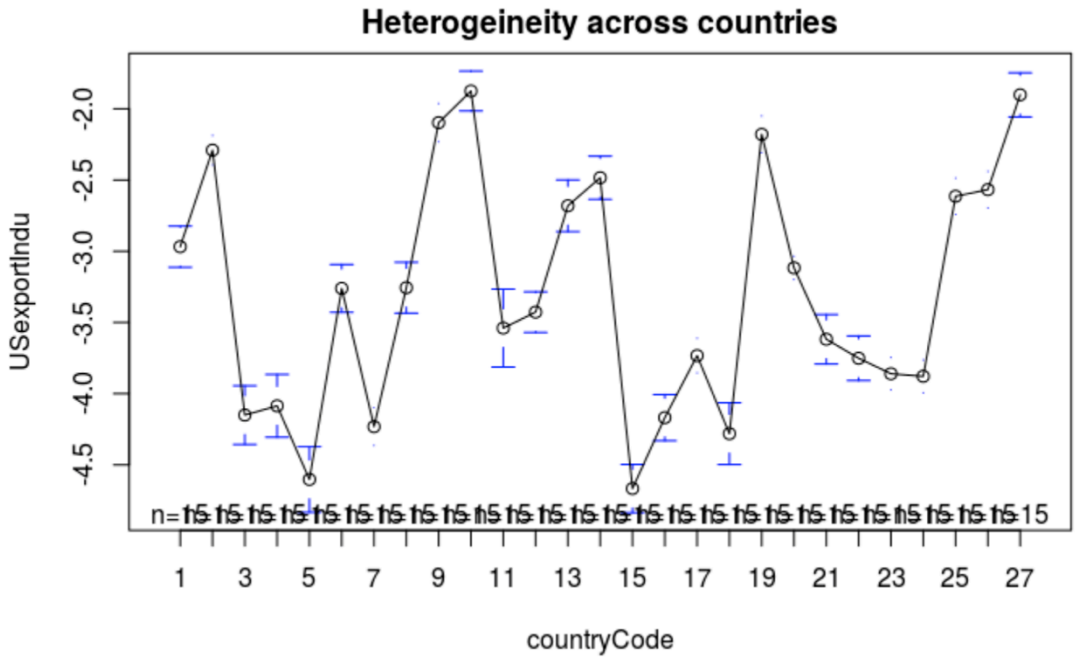

Figure D.2: Exports in industrial sectors

2) China

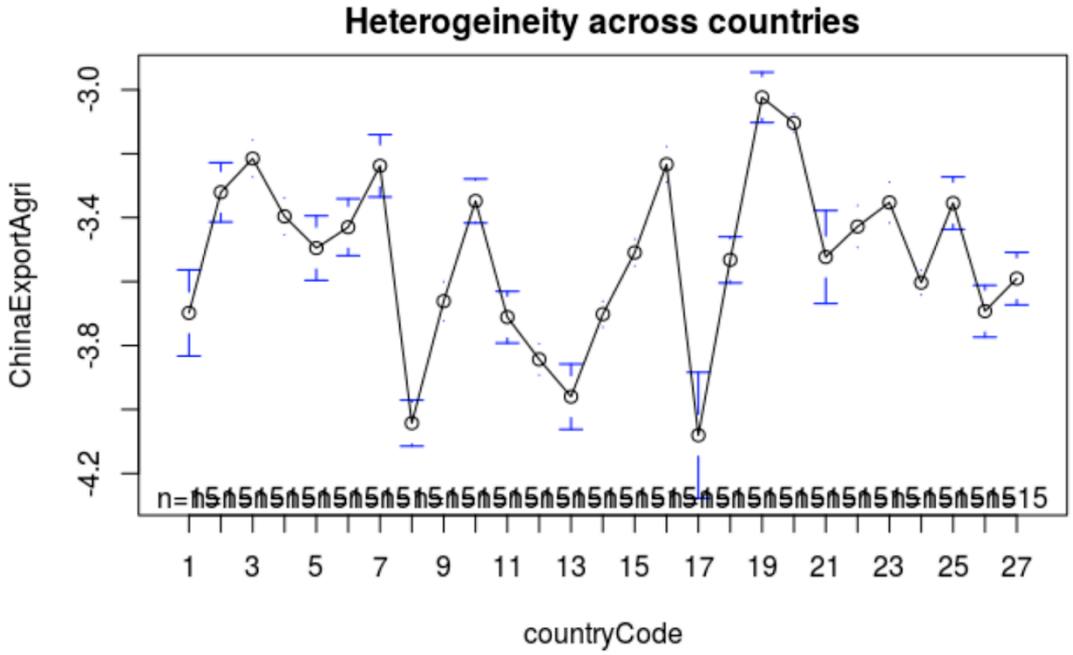

Figure D.3: Exports in agricultural sectors

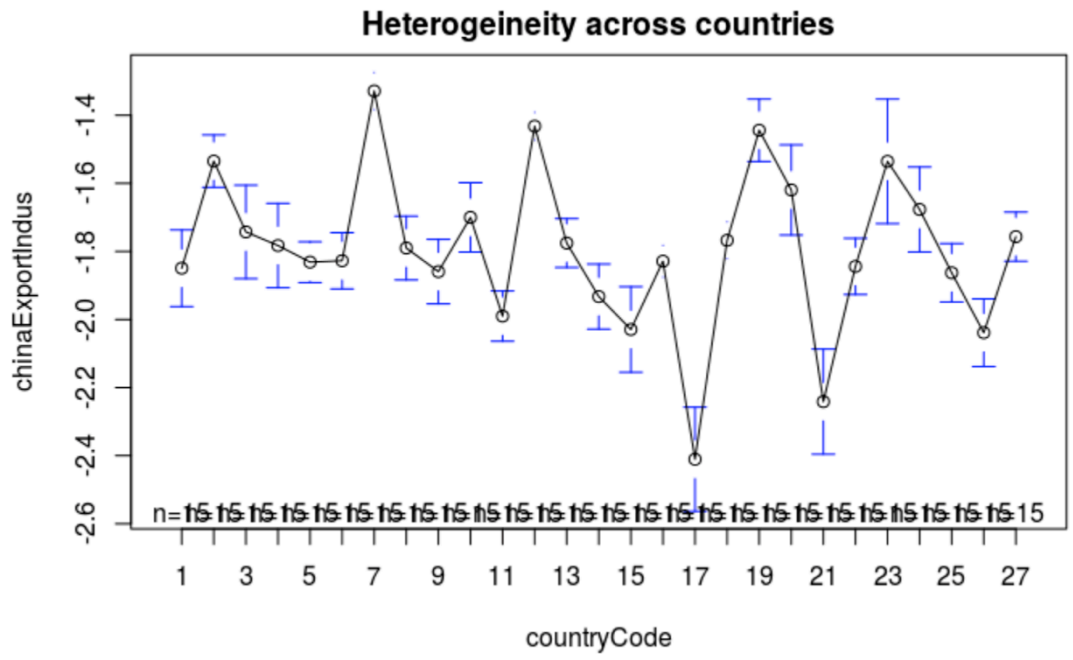

Figure D.4: Exports in industrial sectors